Intergovernmental Oceanographic Commission

EXPERT MISSIONS TO INDIAN OCEAN COUNTRIES TO ASSESS REQUIREMENTS AND CAPACITY FOR AN EFFECTIVE AND DURABLE NATIONAL TSUNAMI WARNING AND MITIGATION SYSTEM

Thailand

Bangkok and Chiang Mai, 18-20 August 2005

Mission Report No 27 **UNESCO**

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English only[1]

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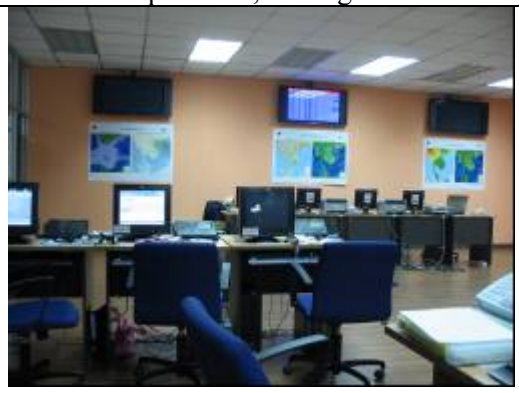
Figure: participants in the meeting, at Chiang-Mai

National Disaster Warning Center (NDWC), Bangkok

Seismic Station of the Meteorological Department, Chiang-Mai

Seismic Research Station, Royal Thai Navy, Chiang-Mai



Operational Room at NDWC, Bangkok

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EXECUTIVE SUMMARY:

In the framework of the establishment of an Indian Ocean Tsunami Warning and Mitigation System (IOTWS), and at the request of the Government of Thailand, an assessment mission coordinated by UNESCO/IOC was conducted in Bangkok and Chiang-Mai, Thailand (18-20 August 2005): (i) to inform national stakeholders on the requirements for the establishment and operation of a tsunami warning and mitigation system; (ii) to assess the available resources; and (iii) to identify capacity building needs.

Experts from UNESCO/IOC, WMO, UN-ISDR, UNESCAP, ADRC, JMA and USGS integrated the mission.

The assessment mission succeeded to reach its goals as defined above and recommended upgrading capabilities of the National Disaster Warning Center (NDWC). Both managerial and technical capabilities of NDWC need to be upgraded. The experts confirmed that, in order to reinforce the Thai System, adequate and upgraded tsunami information is needed from neighboring countries.

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EXPERT TEAM:

- Mr. Masahiro Yamamoto, Tsunami Warning Expert, UNESCO/IOC – JMA expert
- Dr. Walter Mooney, Seismic Expert, USGS
- Mr. Yuichi Ono, UNISDR, Germany
- Mrs. Haleh Kootval, WMO, Switzerland
- Mr. LeHuu Ti, UNESCAP, Thailand
- Mr. Akihiro Teranishi, Disaster Management Expert, ADRC, Japan
- Mr. Bernardo Aliaga, Program Specialist, UNESCO/IOC, France, Team Leader
  (Full addresses are given in Annex 1)

NATIONAL EXPERTS AND AGENCIES PARTICIPATING:

Dr. Plodprasop Suraswadi, Vice Minister to the Office of Prime Minister and Executive Director of NDWC, Thailand

Air-Chief Marshal Anubhund Snidwongse, Deputy Supreme Commander and Vice Executive Director of NDWC, Thailand
Col. Anutat Bunnag, Vice Executive Director of NDWC, Thailand
Col. Wanchai Singthong, Sub Committee Member on NDWC Administration
Capt. Thaworn Charoendee RTN, Hydrographic Department
Mr. Waiyapot Worakanok, Mineral Resources Department
Mr. Suwit Kosuwan, Mineral Resources Department
Mrs. Kamolrat Saringkarnphasit, Meteorological Department
Mr. Thiti Tinnakorn Na Ayudhya, Department of Disaster Prevention and Mitigation
Dr. Cherdsak Virapat, Assistant Executive Director of NDWC, Director of IOI-Thailand
Mr. Miguel Fortes, UNESCO/IOC, Thailand
Ms. Christel Rose, UNISDR, Thailand
Dr. Suvit Yodmanee, Executive Director, ADPC, Thailand
Dr. Tavida Kamolvej, Disaster Management Expert, Pacific Disaster Center
(Full addresses are given in Annex 1)

AGENDA:
Day 1: Arrival and protocol meeting, Presentations by visiting experts and national experts
Day 2: Interviews and discussions of survey,
Day 3: Visit to facilities in Chiang-Mai, final discussions and way forward

1. OPENING OF THE MEETING

Executive Director of the National Disaster Warning Center – NDWC, Dr. Plodprasop Suraswadi, Vice Minister to the Office of Prime Minister, opened the meeting. He welcomed all experts and participants and concluded that NDWC-Thailand was looking forward to receiving critical synthesis, assessment, and constructive recommendation from both international and local experts on urgently needs and capability of the early warning system of NDWC. It was hoped that a comprehensive system would be discussed and addressed at the meeting.

2. OBJECTIVES OF THE MISSION

The purpose of each national assessment mission is:

i. to inform national stakeholders on the requirements (organizational, infrastructural and human resources) for the establishment and operation of a tsunami warning and mitigation system;
ii. to assess the available resources (organization, infrastructure, human resources);
iii. to identify capacity building needs.

3. PRESENTATIONS BY VISITING EXPERTS

Organization: UNESCO/IOC
Bernardo Aliaga, Programme Specialist (delivered by Mr. Yuichi Ono, from UN-ISDR)

In his introduction Mr. Bernardo Aliaga recalled that the objectives of the Indian Ocean Tsunami Warning and Mitigation System (IOTWS) will be (i) to assess national tsunami risk; (ii) to establish national and regional warning systems against local, regional and ocean-wide tsunamis; and (iii) to promote preparedness and risk reduction against tsunami hazard.

Mr. Aliaga then described the accomplishments of the two international coordination meetings that had taken place in Paris, France between 3-8 March 2005, and in Grand Baie, Mauritius between 14-16 April 2005 respectively and that had contributed to development of a governance system for the IOTWS. He referred to the IOC Assembly (23-30 June 2005) that established formally the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS) and to the first meeting of ICG/IOTWS that was held in Perth, Australia 3-5 August 2005. He recalled the high level of commitment of Indian Ocean countries to establish under UN guidance a single process to create a basin wide tsunami warning system.

Mr. Aliaga then recalled the objectives of the mission, as described in 2 above. He noted that so far 18 countries had requested an assessment mission and that 2 teams would visit these during the period June-August 2005. Each mission would be preceded by a pre-mission information gathering (online and paper questionnaires). Each mission would have duration on approximately 3 working days and would be composed of 4-6 members. The teams would include IOC, WMO, and ISDR experts and possibly also a disaster management expert or a seismology expert from Japan or USA. Each mission team would prepare a report.

The national reports would enable countries to more clearly identify their capacity building needs that could be addressed from national resources or could lead to project proposals for submission to donors. Mr. Aliaga explained that further assistance could be provided, in cooperation with relevant agencies, to develop such proposals, as needed.

It was expected that the consolidated report for all missions would provide a detailed overview of existing and required capacity for the entire region that would enable the partner organizations and participating countries to effectively plan and implement the regional elements of capacity building activities such as training courses, public awareness materials etc.

IOC/technical expert (from Japan Meteorological Agency)
Mr. Masahiro Yamamoto,
Director, Earthquake & Tsunami Observations Division Seismological & Volcanological Dept., Japan Meteorological Agency (JMA)

IMPLEMENTATION OF AN EFFECTIVE TSUNAMI WARNING AND MITIGATION SYSTEM

Mr. Yamamoto provided a comprehensive overview of the important components of an effective tsunami warning and mitigation programme using examples and experiences from the IOC's 40-year experience in the Pacific. Tsunamis, which can occur at any time and cannot be predicted, are a global, high-fatality, low-frequency hazard that can strike in minutes, and cause damage for hours and over an entire ocean basin. An effective tsunami early warning system is achieved when all persons in vulnerable coastal communities are prepared and respond appropriately, and in a timely manner, upon recognition that a potentially destructive tsunami is coming. For regional and distant events, timely tsunami warnings issued by an officially-recognized tsunami warning center are essential. When these warning messages are received by the officially-designated government agency, national tsunami emergency response and preparedness components must already be in place so that well-known and practiced actions are immediately taken to evaluate the scientifically-based warning, and communicate an appropriate course of action to ordinary citizens. Tsunami preparedness programme must already have started so that good decisions can be made without delay.

Although a tsunami cannot be prevented, its impact can be mitigated through community and emergency preparedness, timely warnings, effective response, and public education. An effective warning system will be achieved when the following activities are undertaken:

- Identification of the tsunami hazard, assessment of risk, and mitigation to reduce wave impact. Tsunami evacuation maps which show where flooding is likely are based on this information

- Issuance of timely warnings. For a distinct tsunami, real-time earthquake and sea level monitoring to confirm the generation of a destructive tsunami, followed by immediate dissemination to the public, is critical. For a local tsunami where there may not be time for an official warning, people must already know a tsunami's natural warning signals and respond immediately.

- Continuous and sustained awareness activities to sustain preparedness. Education is fundamental to building an informed citizenry and to ensure that the next generation of people are equally prepared. Political support, laws and regulations, and institutional responsibility are key contributions.

In order to achieve an effective system, the activities must be conducted at the same time and actively engage and inform in an understandable manner all stakeholders from the highest government officials to households and disadvantaged and transient populations. Coordination and open information sharing are essential, and an effective mechanism such as

a national tsunami warning coordination or review committee to oversee all activities should be established.

TSUNAMI WARNING CENTER OPERATIONS

Mr. Yamamoto provided an overview of the tsunami warning operations that are carried out at the Pacific Tsunami Warning Center (PTWC) and the Japan Meteorological Agency (JMA). The PTWC provides international tsunami warnings to countries in the Pacific, national warnings to US interests in the Pacific, and local warnings to State of Hawaii. The PTWC also provides tsunami warning assistance to Puerto Rico and the U.S.Virgin Islands. The JMA provides national warnings for Japan, and since March 2005, has provided, in coordination with the PTWC, regional tsunami advisory information through its Northwest Pacific Tsunami Advisory Center to nations in the northwest Pacific. Both the PTWC and JMA are presently providing interim tsunami warning services to the countries of the Indian Ocean.

As warning centers, both centers maintain 24x7 staffing to monitor and respond to potentially tsunamigenic earthquakes. Operational activities include rapid and automatic earthquake analysis using real-time, continuous seismic data streams, monitoring of sea levels received in near real-time through the WMO's GTS system and through other means of direct data transmission, estimation of potential wave impacts or forecasts at selected coasts, and the issuance of standardized tsunami information messages according to the level of threat based on the seismic magnitude and observed tsunami waves through the existing Communication Plan for the Tsunami Warning System in the Pacific. Redundancy in alarms, data, communications, analysis systems, and power is an integral part of their systems to ensure that services do not cease during critical moments. Other methods of analysis were also highlighted, including the TREMORS system for earthquake location and magnitude estimation which has the advantage of requiring only one 3-component seismometer, and deep-ocean tsunami detection systems which can measure tsunami waves in the open ocean, but additionally require significant numerical modeling efforts to estimate coastal wave forecasts. Presently, the PTWC and JMA are able to issue initial tsunami advisories within 10-20 minutes for teleseismic earthquakes, and within 2-5 minutes for local earthquakes. The success of both systems has required the free sharing of seismic and sea level data by all nations. The warnings sent by the warning centers are received by their national emergency operations centers, automatically interpreted and a public-action message immediately disseminated within seconds through various communications media to the public. Warning sirens and mass media broadcasts are well-coordinated in both nations.

In this respect, Mr. Yamamoto emphasized that each country must examine its needs to determine which type of warning system would best fit. Specifically, they should determine where their likely tsunami sources are to be, how long tsunamis will take to impact their coasts, and how much advance notice is required to effect a successful evacuation. For example, Mr. Yamamoto noted that Hawaii requires three hours, and so would need to have a tsunami warning center message at least three hours before the wave arrives in order to sound their sirens. Mr. Yamamoto further noted that for local tsunamis especially, Hawaii has a policy allowing for evacuation vertically to the fourth floor or higher for 'strong' buildings more than six stories in height; this evacuation guidance can be used when there is no time for evacuation inland and away from the coast.

Further, with respect to monitoring systems, Mr. Yamamoto noted that countries do not necessarily need to implement full scale technical monitoring systems if they feel that the message from the interim warning center is sufficient for their purposes. In that case, countries would only need to implement a minimum national tsunami response plan which details the activities and actions that will take place once a warning message is received from the PTWC, JMA, or other warning center.

Finally, the issuance of warnings that produce non-destructive tsunamis was discussed as these "false warnings" can have a detrimental effect on the credibility and long-term effectiveness of a warning center. While presently, evacuations for non-destructive tsunamis may be tolerated, and may additionally serve to exercise the system and better prepare the public, there are economic consequences and other political implications that will arise if too many "false warnings" are issued. Thus, it is absolutely critical that government officials and leaders understand the limitations of a technical warning system.

INDIAN OCEAN INTERIM TSUNAMI WARNING SERVICES

The PTWC and JMA are cooperatively providing interim tsunami advisory information to Indian Ocean countries. The IOC has requested that each Member State provide its 24x7 Tsunami Focal Point for the receipt of this information, and the PTWC and JMA have been providing information to these contacts since mid-April, 2005. The PTWC is providing information according to written guidance provided in its Communication Plan for the Interim Tsunami Advisory Information Service (Initial Draft 11 April 2005), and the JMA through its written guidance, Tsunami Watch Information for the Indian Ocean (15 March 2005). Tsunami Information Bulletins are sent for shallow (< 100 km depth) earthquakes between magnitude 6.5 and 7.0, local tsunami watch bulletins for earthquakes between magnitude 7.1 and 7.5, regional tsunami watch bulletins for earthquakes between magnitude 7.6 and 7.8, and ocean-wide tsunami warnings for earthquakes greater than magnitude 7.8. Messages are being transmitted within 15-30 minutes of the earthquake's occurrence. Messages are sent through the WMO's GTS, email, and facsimile. Monthly communications tests will be carried out to ensure that messages are being received by the designated contacts.

Presently, the PTWC and JMA are providing initial advisory information based only on earthquake information and 12 sea level stations in the Indian Ocean. The Global Seismic Network is presently providing data which are of sufficient density to adequately locate earthquakes in the Indian Ocean. For sea level monitoring, however, only one station, Sibolga, Indonesia, is located in the tsunami source region of the 26 December 2004 and 28 March 2005 earthquakes. Until more stations are installed over the next six months, it will be difficult to provide meaningful evaluation of the destructive potential of a tsunami. Should an ocean-wide tsunami be generated, countries in the western Indian Ocean and Arabian Sea should have an indication of the destructive nature of the tsunami from sea level readings from Sibolga, Indonesia and Colombo, Sri Lanka.

WMO
Haleh Kootval, Chief, Public Weather Services Programme, WMO Secretariat

Ms Kootval outlined the terms of reference of the WMO expert's participation in the mission. These included investigation in detail of the weak links for tsunami warnings and capabilities as part of the multi-hazard approach to early warning dissemination of the NMHSs. She pointed out that in relation to the setting up of an Indian Ocean Tsunami Warning System, WMO had two goals. One was to enhance the national alert and response mechanisms of the countries concerned by assisting the National Meteorological and Hydrological Services (NMHSs) to build up their capacity for timely dissemination of effective tsunami early warnings within a multi-hazard framework and for raising public awareness of risk through Education and Public Outreach Programmes. The other goal was to upgrade the WMO Global Telecommunication System to address information exchange needs for tsunami related data and warnings.

For this mission, an assessment would be made on the capabilities and the needs for enhancement of TMD's capability for timely warning dissemination, on capabilities and requirements for effective cross-training between meteorologists and decision-makers and on

requirements to create greater public awareness for multiple hazards, their prevention and mitigation, so that action could be taken to address those needs. Before the mission, WMO had received the return of Thailand to a preliminary questionnaire prepared and sent to NMHSs of the countries to be visited by the assessment team. Ms Kootval presented the result of that survey which showed the major hazards faced by Thailand with high frequency included severe weather, drought and flooding. It further indicated that in Thailand public awareness was high for all hazards and very high for tsunamis. In the case of local preparedness it was low for all hazards and very high for tsunamis, and national preparedness was very high for all hazards including tsunamis. Public education programmes existed for all hazards but not tsunamis. Thailand had requested for assistance in all areas indicated in the questionnaire for improving its warning system.

Even though Thailand had not requested assistance for upgrading its GTS system and was not on the list of countries which were being visited by WMO GTS experts, for the sake of completeness of report on WMO's tsunami-related activities, Ms Kootval reported on the progress made in upgrading the GTS. Through the multidisciplinary workshop in Jakarta, Indonesia on 14-18 March 2005, twelve out of 27 countries around the Indian Ocean had been identified to be in need of assistance. WMO GTS expert missions were being planned to carry out a technical assessment of the current status of the GTS components in each of these countries, to identify the urgent GTS upgrade needed for the interim phase of the Indian Ocean Tsunami Warning System and to prepare technical specifications for the national GTS upgrade project.

ISDR

Mr. Yuichi ONO, Programme Specialist, UNISDR

Mr. Ono explained the mission of ISDR, which aims at building disaster resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development. This mission is been pursued by the coordinated action of the Inter-Agency Task Force on Disaster Reduction (IATF), the Inter-Agency Secretariat of ISDR, National committees / platforms, and Partner institutions and Regional Centers. Within this first part of his presentation he referred to the World Conference on Disaster Reduction (WCDR-2005) that aimed to increase the international profile of DRR, promote its integration into development planning and practice, and strengthen local and national capacities to address the causes of disasters. WCDR provided a timely forum for the tenure of Two Special sessions on the Indian Ocean Tsunami Disaster: the first addressed the experiences and lessons learned and the second promoted the tsunami early warning system.

UN-ISDR has a Platform for the Promotion of Early Warning and International Early Warning Programme, based at Bonn, Germany. This platform builds on four components: Risk knowledge, Warning service, Dissemination (Communication), and Response capability (Preparedness). Early warning system failures typically occur in communication and preparedness, but for the Indian Ocean tsunami all four failed.

Mr. Ono then referred in detail to the Early Warning Strengthening Project launched in the framework of the UN Flash Appeal. This project looks at the Evaluation and Strengthening of Early Warning Systems in Countries Affected by the 26 December 2004 Tsunami. The project amount is for USD $11M and received donations by Japan (USD 4 Million), Sweden (USD 1.4 Million, and Norway (USD 1.4 Million) and pledges from European Commission (USD 2.6 Million), Finland (USD 1.3 Million) and Germany (USD 0.39 Million). This project is being undertaken primarily through partnerships between UN and other organizations. More than half of the funds received by ISDR will be transferred to partners.

The last part of Mr. Ono presentation addressed the check points ISDR is considering in the framework of the national assessments: Tsunami Early Warning System is developed into countries' other disaster risk management and reduction activities, as indicated by the Hyogo Framework of Action 2005-15 during the WCDR; Coordination within the country is important (ISDR promotes to reinforce or establish the National Platform in each country); National Platform (National Disaster Management Office-NDMO) functions as a focal point. UN-ISDR is looking to identify NDMO's roles in response to tsunami warning issued by national tsunami warning authority through:

assessing the linkage between the two agencies

assessing the mechanism of NDMO (flow chart?)

assessing how NDMO coordinates with other sectors of the government for preparedness

assessing if such linkage or coordination is sustainable (in other words, assess tsunami disaster risk reduction is integrated into actual policy in each sector of the government – education, development, humanitarian, police, land-use, health, emergency relief, etc.)

Furthermore, ISDR look forward to assess local government / community's roles in response to tsunami warning, evaluating the linkage between NDMO and local governments / communities. In this sense, media aspects are important, particularly in terms of linkage with government authorities. To assess the coordination between the National Tsunami Warning Center and media and to make sure the receivers understand the message and what to do are also important steps. He also referred to preparedness and to the international coordination.

3.1 USGS

By Dr Walter Mooney, U.S. Geological Survey

Dr. Walter D. Mooney of the U.S. Geological Survey provided an overview of the seismological observations regarding tsunamis and earthquakes. On Dec. 26, 2004, the world experienced one of the worst natural disasters of the past 100 years when the magnitude 9.3 earthquake generated a tsunami that devastated many coastal regions of the Indian Ocean. There was a tremendous outpouring of humanitarian assistance from numerous nations around the world in response to this highly unexpected event. The tragedy sparked wide-spread heightened interest in tsunamis and earthquakes, not only among the public and media (T.V. and press) but also in the scientific community. Important questions were raised as to how such a disaster could have happened without warning, and even a long-term forecast of risk. Many of the questions also reflected a general fear in the world's coastal and earthquake prone regions as to whether it was possible for a similar event to happen at home. For example seismologists were frequently asked questions from the press and public at large whether other portions of the SE Asian region could ever be hit by a large tsunami. It soon became apparent to us that many people, including those of the press and T.V. media, had forgotten the history of some past natural disasters. For example, very few people have never heard of the M=9 earthquake in 1700 in western North America that caused a tremendous tsunami that crossed the Pacific Ocean to devastate Japan.

Dr. Mooney described many seismological observations for the 2004 Great Sumatra-Andaman Islands earthquake. Using computer simulation models, he demonstrated several important concepts, including (1) how seismic waves travel through the Earth; (2) how long (500 s.) and how far along the fault (1,300 km) the earthquake moved; and (3) how this earthquake generated a large tsunami that moved at about 600 km/hr across the Indian Ocean basin. All of these educational materials were provided to the host for their use.

He concluded by describing recent technical developments in the Indian Ocean region that will improve the monitoring of potential tsunami-generating earthquakes. This includes

the staffing of some national centers in the United States on a 24 hour/7 days a week basis. Additional improvement in earthquake monitoring and tsunami warning can be expected as the national of the Indian Ocean region build their infrastructure and human capacity.

UNESCAP

Mr. Ti Le-Huu, Officer-in-Charge of Water Resources Section,

Mr. Ti Le-Huu provided experiences of regional cooperation for early warning and disaster preparedness implemented over the past several decades under the framework of subregional networks established by UNESCAP, such as the Typhoon Committee, the Panel on Tropical Cyclones and the Mekong River Commission.

Mr. Ti Le-Huu also presented the results of a research carried out by UNESCAP and its consultant on trends of socio-economic impacts of natural disasters in selected countries in the region and the relationship between effects of investment in disaster risk management and reduction in annual impacts of water-related disasters. He also briefly mentioned some of ongoing activities of UNESCAP related to strengthening capacity of developing countries on disaster risk management."

3.2 ADRC

By Mr. Akihiro Teranishi, Senior Researcher, ADRC

Mr. Teranishi provided a comprehensive overview of the tsunami disaster management system in Japan as a good practice for establishment of tsunami early warning system.
His presentation is consists of three components;

- Tsunami and Japan
- Outline of disaster management in Japan
- Raising public awareness

From the old days, Japan has been suffered from tsunami disaster repeatedly and such experience made the present Japanese tsunami countermeasures; structural countermeasures such as construction of sea walls, and tsunami early warning system.
In Japan, there is a basic law on disaster management named Disaster Management Basic Act, which is the basic disaster management regal framework in Japan. The concept of this law is comprehensive disaster management in which all stakeholders are involved. He then showed a short movie of how disaster countermeasures are implemented in each disaster phase and by each stakeholder.

Tsunami warning is issued by Japan Meteorological Agency and disseminated through national and local governments as well as mass media. As tsunami may arrive within a very short-time, it is critical to rapidly make early warning to residents. When an earthquake occurs near the shore the public should evacuate immediately, even before the tsunami warning is issued.
Regarding preparedness in the community level, he explained the importance of education in schools. Through disaster management education and drills in schools, students are aware about what is a tsunami and how to evacuate, for tsunami as well as other natural hazards. There are disaster management educational materials in Japan for each school grade.

Mr. Teranishi also expressed that to pass on the experiences and lessons learnt is important to raising public awareness. There are some signboards that show the height of past tsunamis and also a memorial center in Japan.

4. PRESENTATIONS BY NATIONAL EXPERTS

NDWC

Dr. Solarwish Saikasem
Adviser/Chief Expert,
National Disaster Warning Center, Thailand

The National Disaster Warning Center was established under the Order of the Office of the Prime Minister. It is a Prime Minister Thaksin Shinawatra's political commitments to protect lives and properties of Thai people and foreign visitors by setting up the National Disaster Warning Center as soon as possible.

On December 26, 2004 there was a huge earthquake in the sea in the northwest of the Sumatra Island with magnitude of 9.0 on the Richter scale. A great Tsunami approached the Andaman coasts of Thailand at Phuket, Pang-nga, Krabi, Trang, Satoon and Ranong causing 5396 casualties of Thais and foreign tourists. About half of this number was foreigners. 8,457 people were injured and 2,951 people disappeared. 880 children were orphaned. The disaster affected the tourism industry along the Andaman coast of Thailand for more than 30,000 million baht. Thai properties and natural environments suffered extreme destruction. This could be regarded as the most severe disaster that has ever occurred in Thailand's history. In foreign countries, there were also tremendous calamities at Indonesia, India, Sri Lanka, Myanmar, Bangladesh, Mauritius, the Maldives, Seashells and beyond to Kenya and Somalia. Over 200,000 people of these countries died from this Tsunami disaster. This was the most severe natural disaster in the history of countries around the Indian Ocean.

The National Disaster Warning Center was officially opened on May 30, 2005 located on Rattanathibet Road, Bangkrasor Sub-district, Muang District, Nonthaburi Province.

The major task of the National Disaster Warning Center is to detect earthquake and to analyze seismic data to determine the possibility of a Tsunami generation before issuing notification messages to the public and related authorities and rescuers for evacuation of people into safe places. This is to prevent the loss of people's lives and their properties as much as possible.

From now on, The National Disaster Warning Center will be developed, upgrade of its early warning system and extended its telecommunication networks to be able to cope with multi-hazards disasters apart from Tsunamis, such as:

- Severe Floods
- Land Slides
- The collapse of Dams
- Tropical Storms
- Wild Fires
- Air Pollution, Water Pollution and Oil Spills

For the next 2 years, the National Disaster Warning Center will be developed into a regional center to collaborate with other existing regional centers. This is to help the Indian Ocean and Southeast Asian countries to be able to maintain safety from natural disasters that may occur at any time.

In addition, the National Disaster Warning Center will provide capacity building and training to the staff/officers of Thai governmental departments, local communities and neighboring countries to provide early warning messages to authorities and related agencies.

For warnings of earthquakes and Tsunamis, the National Disaster Warning Center receives information from the Meteorological Department and various agencies through their seismic

stations located in Thailand such as the Royal Thai Navy, the Electricity Generating Authority of Thailand (EGAT) and the Royal Irrigation Department. The National Disaster Warning Center also receives information on sea level change from the Hydrographic Department of the Royal Thai Navy. In addition the National Disaster Warning Center gets information from global seismic networks such as the Pacific Tsunami Warning Center (PTWC), Hawaii, U.S.A., Japan Meteorological Agency (JMA), Japan and from nearby countries such as Indonesia and Malaysia. Telecommunication systems include telephone, facsimile and electronic mail. This is to issue notification messages within 5-10 minutes to VIPs, rescuers and related agencies involved such as fire extinguishing stations, hospitals, schools and police stations.

Experts from Meteorological Department and Department of Geological Survey and Earthquake then analyze the information, before decision can be made to issue warning message in according to levels of severity as determined by the Standard Operating Procedures (SOP) Manual.

A SMS system is used to inform VIPs and rescuers. For public broadcast, Television Channel 5 (the Army Television Station) is used, as it is the main authorized television station for dissemination of warning messages to the public on a nation-wide basis by linking networks to broadcast via satellite communications. Warnings are also announced on the Television Pool of Thailand through 42 communication systems of the Mass Communication Organization of Thailand, 64 radio stations network of the Public Relations Department, and through 216 radio stations of the CAT Telecom Public Company Limited and to link with the SMS system of about 20 million mobile phones to disseminate warning information. The early warning system will also link with the rural village loud speakers to provide alerting signal simultaneously.

The National Disaster Warning Center provides a Call Center to render 24-hour services to give information to those who want to know detailed information and to monitor disaster situation/ movement.

In addition, the Hydrographic Department of the Royal Thai Navy at the Similan Island (Koh Miang) uses tide gauges to detect sea level change and to confirm tsunami generation by computer system on a real time basis.

The information can be transmitted to the Hydrographic Department Headquarter in Bangkok and the National Disaster Warning Center in Nonthaburi at the same time through satellite communications.

According to the method being used by the National Disaster Warning Center, which is considering a conservative method, referring to criteria and procedures that are aiming at maximizing safety and avoiding the use of human individual judgment.
However, it is being seen as assuring, accurate and clear-cutting method. It has been determined that after the opening of the National Disaster Warning Center, there have been follow-ups of earthquakes and warnings have been done without mistakes.
In addition, with the cooperation of staff of the Disaster Prevention and Mitigation Department in local areas, there have been suppositions of emergency programs for evacuation and the provision of shelters. This is to ensure that Thais and foreign visitors will be safe from Tsunamis forever.

5. OTHER PRESENTATIONS

Dr. Suvit Yodmanee, Executive Director, Asian Disaster Preparedness Center (ADPC) made a presentation on Establishing Regional End-to end Multi-hazard Early Warning System in Southeast Asia from an International Agency point of view.

Dr. Yodmanee introduced that in early January 2005, the Royal Thai Government (RTG) requested ADPC to support the development of Thailand's national tsunami early warning capabilities and at the same time proposed to establish and operate an end-to-end multi-hazard early warning system, with ADPC as a regional center or focal point. This proposal was brought forward in the Special ASEAN Leaders' Meeting in Jakarta and, again, in the Ministerial Meeting in Phuket.

In late March 2005, a senior officials "Regional Meeting on End-to-end Multi-hazard Early Warning System in Southeast Asia: Assessment of Needs", participated by Cambodia, China, Lao PDR, Myanmar, the Philippines, Thailand and Vietnam, noted the exclusion of Southeast Asia in the discussions of the IOC International Coordination Meetings despite the intents expressed in the Jakarta Special ASEAN Leaders' Meeting and the Phuket Ministerial Meeting, the potential tsunami threats in the Gulf of Thailand and South China Sea, and the need for warning system in Southeast Asia as identified by the Tsunami Warning System in the Pacific (ITSU) Master Plan.

Thailand initiated the Multi-Donor Voluntary Trust Fund for Tsunami Early Warning Arrangements in the Indian Ocean and Southeast Asia, to which Thailand pledged US$ 10 million as seed money.

Through a couple of expert consultation meetings, ADPC has finalized the technical system design and developed an implementation plan for the establishment of an end-to-end multi-hazard early warning system in Southeast Asia, with initial focus on tsunami early warning. Based on this finalized technical system design and an implementation plan, ADPC has developed project proposals within national capacity assessment, risk assessment, warning and dissemination, and preparedness and awareness to be presented to development organizations and donor agencies in order to mobilize the necessary funding resources.

In November 2005, the NDWC and ADPC reported that the NDWC and ADPC signed their memorandum of understanding on cooperation on early warning arrangement, preparedness and mitigation on natural hazards for Thailand on 6 September 2005 in Phang-nga, South of Thailand, after Cabinet approval (Annex III). The areas of cooperation include early warning arrangement, preparedness and mitigation of natural hazards for Thailand and the establishment of cooperative linkages between ADPC and NDWC. Presently, the TMD is providing information on seismicity directly to NDWC where NDWC analyzes the information and provides the early warning as determined by its Standard Operating Procedures. Close collaboration exists between the TMD and NDWC. At a later date, the seismic center and earthquake stations are planned to be separated from TMD and a technical body called the Office of Earthquake, linked to the NDWC, will be created in the Mineral Resources Department under the Ministry of Natural Resources and Environment (MONRE). Presently, the ADPC plans to upgrade seismic and sea level stations throughout the region and share data in real time. It is supporting IOC GLOSS efforts to upgrade sea level stations in Myanmar in 2005.

6. VISITS TO METEOROLOGICAL RESEARCH STATION OF THE ROYAL THAI NAVY AND THE SEISMIC STATION OF THE METEOROLOGICAL DEPARTMENT.

The assessment team met visited on the 20th August 2005 the facilities of the Meteorological Research Station of the Royal Thai Navy and the Seismic Station of the Meteorological Department, both localized in Chiang-Mai Province, north of Thailand. At both sites the team was provided with valuable information about the capabilities of the Meteorological Department and the Royal Thai Navy in terms of equipments and human resources in the Thai network of seismic events monitoring. Up to date equipment and networks were observed in both sites, relied to CTBTO (Thai Navy) and to the IRIS-FSGN network (Meteorological Department).

7. COUNTRY ASSESSMENT INTERVIEW – SUMMARY

Two questionnaires were available for review and discussion:

- Preliminary WMO questionnaire for National Meteorological and Hydrological Services for development of tsunami early warning and mitigation system in the Indian Ocean
- IOC country assessment questionnaire on tsunami warning and mitigation activities

The information obtained prior to the Mission was reviewed extensively during the Meeting and corrected or complemented as necessary. The revised version of the IOC questionnaire results is available in Annex II. Conclusions and Recommendations for this section are summarized and listed under Section 8.

8. CONCLUSIONS AND RECOMMENDATIONS

Based upon the discussions during the Meeting, the experts formulated the following conclusions and recommendations for further action. These were discussed during the last day of the mission. A copy was provided to the host country as it may assist in the process of the establishment of the National Tsunami Coordination Committee and Tsunami Warning Centre.

8.1 AUTHORITY AND COORDINATION

The Committee on the Study of the Disaster Early Warning System was established under the authority of the Prime Minister in January 2005. This committee appointed the sub-committee on National Disaster Warning Center (NDWC) Administration. The NDWC was opened in June 2005, and was identified as the national focal point for the interim tsunami warning system for the Indian Ocean.

The Department of Disaster Prevention and Mitigation (DDPM) and the Department of Provincial Administration (DPA) both play an important role in the coordination of disaster management at the regional, provincial and local level. DDPM operates 12 regional centers with a large network of volunteers.

The creation of the NDWC represents progress. However, at present, the NDWC is led by management whose role has been the establishment of the Center. The immediate need is for the appointment of a longer-term leadership structure that will provide the NDWC with stable management and a clear vision of the way forward. This should encompass both the technical side and the overall administrative needs.

There is a need for a detailed written description of the present and future roles and responsibilities of the NDWC. In addition, there is a need for a clear description of the linkages with all relevant national organizations, especially the Thai Meteorological Department (TMD), DDPM, DPA, and the Armed Forces.

Potential collaboration with the ADPC should be clarified.

8.2 TSUNAMI WARNINGS AND TSUNAMI MONITORING

The upgrade of the seismic stations is planned. The upgrade of sea level stations and installation of additional sea level stations, including DART buoy, is planned. In order to enhance the network capability, the seismic and sea-level stations should be updated in coordination with the activities of WG-I and II (Seismic network and Sea-Level network, respectively) of the ICG/IOTWS.

The exchange of information and seismic and sea level data are essential for the Indian Ocean Tsunami Warning System. Therefore, the National Tsunami Warning System of Thailand should be established based on principles and guidance agreed under ICG/IOTWS.

The installation of the dedicated tsunami warning system is planned. As the incoming data increases, the update of the system shall be carried out accordingly. Continued upgrade of assessment procedures shall include new data as it becomes available.

It is recommended to have a cadre of highly skilled, competent, and specialized professional and technical staff in NDWC.

The GTS communication system to exchange the information among National Tsunami Warning Centers as well as sea level data is the most reliable, fastest and cost effective route. Therefore, NDWC should be connected to GTS.

Although, capability exists in the country to use satellite technology to provide imagery and information through meteorological satellites (GMS, METEOSAT) , as well as other remote sensing data through LANDSAT, IKONOS, and communication satellites such as INMARSAT, assistance in the form of technical expertise, maintenance programmes as well as adequate funding is required.

Early and certain delivery of tsunami information to the public is essential. Therefore, notification systems to the public and protocols for delivering warning should be amended, based on the results of drills. The protocols should have clear lines of command to avoid confusion and the waste of time in critical situations.

As far as the safety of mariners and coastal zone users is concerned, it is important to use mechanisms for alerting them that are suitable for their particular needs and circumstances. For example, in the case of vessels equipped with radio and other telecommunication devices, satellite communication can be used to disseminate warnings. In the case of small fishing boats where no such equipment exists on board, a simpler and practical approach, such as the use of light signals, should be employed.

8.3 TSUNAMI WARNING RESPONSE AND EMERGENCY PREPAREDNESS

Thailand has a complete system of tsunami warning response with criteria and plans, as well as operational rules and responsibilities of the national/local governments. In order to reinforce these plans, adequate and upgraded information such as tsunami arrival time and height, and the affected area is needed

A plan for structural measures such as conservation/plantation of mangroves, construction of sea walls and evacuation shelters/mounds should be considered.

Investment is required for building more warning towers which can also be used as evacuation shelters.

8.4 TSUNAMI HAZARD AND RISKS

It is clear that Thailand, like other nations in the Indian Ocean region, only recently became aware of its tsunami prone-risk areas. However the rapid response, such as the production of inundation maps for evacuation strategies, is a very good first step towards assessing hazards.

Technical assistance is needed in several areas, including (but not necessarily limited to) the following areas: digital elevation maps, bathymetric cartography, GIS training, numerical modeling of inundation, and the production of hazards and vulnerability maps.

A good historic registry of earthquakes exists for Thailand, but technical assistance is requested for geological studies of previous tsunamis.

Training and technical assistance may be needed for post tsunami surveys and documentation of structural and non-structural damages from tsunamis and earthquakes.

8.5 PUBLIC AWARENESS AND PREPAREDNESS

There is a strong need for the identification of a central body to coordinate the activities of all organizations that play a role in disaster reduction, in agreement with the Hyogo Framework of Action.

DDPM conducts a multi-hazard drill (training of trainers for regional, provincial and local civil servants) once a year. Tsunami drills have recently been conducted by DDPM in 6 Provinces every month. There is a need to evaluate the outcomes of these drills in several elements (i.e. evacuation of more vulnerable populations, consumed time for evacuation, etc.). Evacuation drills should be conducted regularly at schools, hospitals and other public facilities. Standard evacuation symbols for evacuation routes are needed.

Red Cross, other NGOs, volunteers such as Civilian Disaster Prevention Volunteers Unit and Civil Defense Volunteers, and other social organizations are actively involved in disaster preparedness and emergency response activities at local level. They should be well coordinated with national agencies, including Local Administrative Organizations (LAOs) under DPA, which will play a major role in receiving and disseminating the warning.

There is a need for reproducing public awareness materials for tsunami made by Ministry of Natural Resources for wider dissemination. Investment is required for building a tsunami memorial /museum in Phang Nga.

Development of educational and public outreach programmes which in addition to tsunamis also cover other natural hazards such as cyclones and storm surges, are in the planning stages. Cooperation with international as well as national and local organization such as UNESCO/IOC, WMO, ADPC, PDC, ADRC, USAID, the Thai Department of Disaster Prevention and Mitigation, and the Thai Ministry of Education is required and should be facilitated in the development of educational modules and materials and conducting training activities to strengthen linkages with key organizations involved in the early warning process.

Development of a multi-hazard approach in the country using a durable and effective national early warning system in the framework of Tsunami Early Warning System is intended. This should be encouraged and supported in order to gain benefits from the capacities being developed to better respond to all hazards.

ANNEX I: LIST OF PARTICIPANTS

NAME	ORGANISATION	DESIGNATION	PHONE NO.	E-MAIL
Dr. Plodprasop Suraswadi	Prime Minister Office and NDWC	Vice Minister to the Office of Prime Minister and Executive Director of NDWC	Tel. 66-1-8151001,	plodprasop.s@dasta.or.th
Air-Chief Marshal Anubhund Snidwongse	NDWC	Deputy Supreme Commander and Vice Executive Director of NDWC	66-1-9874462, 66-2-5756146	
Col. Anutat Bunnag	NDWC	Vice Executive Director	Tel. 66-2-2790430, Fax 66-2-2797992,	bunnag@pacific.net.th
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Mr. Thiti Tinnakorn Na Ayudhya	Department of Disaster Prevention and Mitigation		ph. 66-9-1171003	
Dr. Cherdsak Virapat	NDWC	Assistant Executive Director, Director of IOI-Thailand	Tel. 66-2-5892497 ext 24, Fax. 66-2-5892497 ext 22, Mobile Ph. 66-9-9691587	cvirapat@hotmail.com
Mr. Miguel Fortes	UNESCO/IOC	Head of WESTPAC Office, Bangkok		m.fortes@unescobkk.org
Ms. Christel Rose	UNISDR	Programme Specialist		rosec@un.org
Dr. Suvit Yodmanee	Asian Disaster Preparedness Center (ADPC)	Executive Director		suvit@adpc.net
Dr. Tavida Kamolvej	Pacific Disaster Center	Disaster Management Expert		tavida_k@yahoo.com

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ANNEX II

COUNTRY ASSESSMENT QUESTIONNAIRE ON TSUNAMI WARNING AND MITIGATION ACTIVITIES

SECTION 1: CONTACT INFORMATION (NAME, ADDRESS, PHONE, FAX, E-MAIL)

Question 1: *Please identify or confirm the national points-of-contact who we can work with for tsunami mitigation activities in your country. Mitigation activities include tsunami warning and emergency response and preparedness, and education and outreach. Typical agencies involved in these activities are the national emergency response agency, meteorological services, and universities or other technical agencies operating seismic and/or sea level networks or conducting numerical modeling or other engineering studies.*
Answer: The National Points-of-Contact who UNESCO/IOC can work with for tsunami mitigation activities in Thailand are:

1) Executive Director, National Disaster Warning Center of Thailand (NDWC-Thailand)
Rattanathibet Road, Bang Kra Sor, Muang, Nonthaburi 11000, Thailand
Tel. +66-2-5892497
Fax. +66-2-5892497 ext 22
Mobile ph. +66-1-8151001, +66-9-9691587
e-mail: plodprasop.s@dasta.or.th, cvirapat@hotmail.com

2) Director-General, Department of Disaster Prevention and Mitigation (DDPM)
3/12 U-Thong Nok Road, Wachira, Dusit, Bangkok 10300, Thailand
Tel. +66-2-2430020-27, 2417470-84
Fax. +66-2-2417466, 2417499
Mobile ph. +66-1-3897777, +66-1-9167409
e-mail: soonthorn@disaster.go.th

3) Director General, Thai Meteorological Department
4353 Sukumvit Rd, Bangna, Bangkok, Thailand 10260
Tel. 662-3994547
Fax. 662-3990968, 662-3990974

SECTION 2: AUTHORITY AND COORDINATION

*Scope**:** Please outline your country's situation regarding authority and coordination. Below are some questions that should be considered in providing a description.*

2A: LEGAL FRAMEWORK

Question 2: *Does your country have laws which designate specific government agencies to provide science-based warnings to specific government agencies, disseminate public warnings instructing the public to take or prepare to take actions, and to provide appropriate emergency response after a destructive tsunami to the affected communities? Please briefly describe these, listing the laws or administrative rules or similar legislation, the agencies designated, and their roles and responsibilities.*
Answer: The Order of the Office of Prime Minister No. 16/2548 dated of 11 January 2005, Order of the Committee on Study of the Disaster Early Warning System No. 4/B.E. 2548 dated of 21 February 2005 the Appointment of Sub-Committee on National Disaster Warning Center Administration (replaced by No. 17/B.E. 2548 dated of April 8, 2005), the Civil Disaster Prevention Acts B.E. 2522 (1979) and National Plan for Civil Disaster Prevention B.E. 2548 (2005) are legally designate specific government agencies to provide science-based warnings to specific government agencies, disseminate

public warnings instructing the public to take or prepare to take actions, and to provide appropriate emergency response after a destructive tsunami to the affected communities. These are as follows:

Order issued by Office of Prime Minister
No. 16/B.E. 2548
Title: Appointment of Committee on Study of the Disaster Early Warning System

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As the Office of Prime Minister issued the order No. 1/B.E. 2548 dated of 4th January B.E. 2548 entitled Assignment for Vice Minister of the Office of Prime Minister (Mr. Smith Dharmasaroja), acting Chairman of the Working Group on Study of Disaster Early Warning System, with authorization to study and conduct research with Thai and international scientists to obtain good and appropriate system for Thailand.

Using authorization stated in rule II (26) and (9) of the Civil Service Administration Acts B.E. 2538, Prime Minister has appointed a Committee on Study of Disaster Early Warning System with component and authority as follows:

1. Component

1.1 Mr. Smith Dharmasaroja	**Chairman**
1.2 Mr. Suvit Yodmani	**Vice-Chairman**
1.3 Representative, Ministry of Communication	**Committee**
1.4 Representative, Ministry of Natural Resources and Environment	**Committee**
1.5 Representative, Ministry of Interior	**Committee**
1.6 Representative, Ministry of Education	**Committee**
1.7 Representative, Ministry of Public Health	**Committee**
1.8 Representative, Red Cross Foundation	**Committee**
1.9 Mr. Thira Sutabutra	**Committee**
1.10 Mr. Seree Supharatid	**Committee**
1.11 Mr. Plodprasop Suraswadi	**Committee**
1.12 Mr. Panitan Lakkunaprasit	**Committee**
1.13 Mr. Pennung Warnitchai	**Committee**
1.14 Mr. Viraphol Taesombut	**Committee**
1.15 Representative, Ministry of Information, Communication and Technology	**Committee and Secretary**
1.16 Miss Somsri Huntrakoon	**Committee and Assistant Secretary**
1.17 Officer, Department of Meteorology	**Committee and Assistant Secretary**

2. Authority

2.1 Study all types and characteristics of disasters as will occur and affect lives and property of people, government's property, agricultural system, agricultural farms, polluted environment, industrial system, economic and security of the country;

2.2 Study and survey on data related to responsible agencies for surveillance and inspection of data on all types of disasters as will occur in Thailand;

2.3 Study and survey readiness and availability of scientific equipment for disaster detection under responsibility of governmental agencies as in 2.2;

2.4 Study and conduct research on human resources quantity being responsible for surveillance and inspection of data for disasters which will occur in Thailand;

2.5 Considering establishment of a National Committee on Disaster Early Warning to synthesize and verify warning messages from all related agencies to provide early warning for all types of disasters to the public;

2.6 Warning to synthesize and verify warning messages from all related agencies to provide early warning for all types of disasters to the public;

2.7 Survey, study and plan on setting up communication system of warning message among agencies responsible for detecting data on disasters to be presented to a National Committee on Disaster Early Warning and responsible agencies on dissemination of warning messages through radio, TV, transmitted radio and other telecommunication modes with effectiveness and prompt quality of works;

2.8 The Committee on Study of Disaster Early Warning System shall proceed with urgency and report progress of work directly to Prime Minister periodically as deem appropriate;

2.9 The Committee will be able to appoint Sub-Committee, working group or responsible person to study, consider or examine any special issue as required.

Disbursement for per diem, traveling expense and all administration costs in conducting research and survey including other expenses necessary for operation under this order will be borne by the Office of Prime Minister.

Effective as of today,

Dated of 11th January B.E. 2548

Police Lieutenant Colonel

(Thaksin Shinawatra)
Prime Minister

Order issued by the Committee on Study of the Disaster Early Warning System
No. 17/B.E. 2548
Title: Appointment of Sub-Committee on National Disaster Warning Center Administration

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As the Committee on Study of the Disaster Early Warning System issued the order No. 7/B.E. 2548 dated of 28 February B.E. 2548 appointed the Sub-Committee on National Disaster Warning Center Administration and the order No. 11/B.E. 2548 dated of 20 March B.E. 2548 amended the order on Sub-Committee and Secretary of the Sub-Committee.

In order to render the National Disaster Warning Center to be operated effectively and be able to achieve works being assigned using authorization stated in No. 2.8 of the Order of Office of Prime Minister No. 16/B.E. 2548 dated of 11th January B.E. 2548 to cancel the order of the Committee No. 7/B.E. 2548 and No. 11/B.E. 2548 and to appoint a Sub-Committee on National Disaster Warning Center Administration with component and authority as follows:

1. Component

1.1 Mr. Plodprasop Suraswadi — Chairman of Sub-Committee (Acting Executive Director)

1.2 Air Chief Marshal Anubhund Snidwongse — Vice Chairman of Sub-Committee, (Acting Vice Executive Director)

1.3 Mr. Manas Songsang — Vice Chairman of Sub-Committee, (Acting Vice Executive Director)

1.4 Col. Anutat Bunnag — Vice Chairman of Sub-Committee, (Acting Vice Executive Director)

1.5 Representative, Ministry of Interior — Sub-Committee
1.6 Representative, Ministry of Defense — Sub-Committee
1.7 Representative, Ministry of Foreign Affairs — Sub-Committee
1.8 Representative, Department of Meteorology, Ministry of Information, Communication and Technology — Sub-Committee
1.9 Representative, Department of Disaster Prevention And Mitigation, Ministry of Interior — Sub-Committee
1.10 Representative, office of the National Police — Sub-Committee
1.11 Representative, Department of Mineral Resources — Sub-Committee
1.12 Representative, Royal Irrigation Department — Sub-Committee
1.13 Representative, Pollution Control Department — Sub-Committee
1.14 Representative, National Parks, Wildlife and Plant Conservation Department — Sub-Committee
1.15 Representative, Department of Public Relations, Office of Prime Minister — Sub-Committee
1.16 Representative, CAT Telecom Public Company Ltd. — Sub-Committee
1.17 Representative, Radio Amateur of Thailand — Sub-Committee

1.18 Sub. Lt. Jaroug Sreevanich Sub-Committee and Secretary,
1.19 Representative, Office of Permanent Secretary, Ministry of Information, Communication and Technology Sub-Committee and Assistant Secretary, (Acting Assistant Manager)
1.20 Mrs. Ratana Samart, Sub-Committee and Assistant Secretary, Office of Prime Minister's Secretary Office (Acting Assistant Manager)

2. Authority

2.1 Provide national warning system for immediate implementation as follows;

2.1.1 Coordinate, inspect and obtain information from related agencies in Thailand and other countries;

2.1.2 Act as a center of intelligence for communication network to issue warning messages to public with promptness, on time and effectiveness.

2.2 Issue regulations on effective warning message to be compliance with law in according to activities of each responsible agency;

2.3 Monitor and inspect exercises of early warning message and response of related agencies in according to predetermined action plan;

2.4 Administer and control operation of the National Disaster Warning Center as follows:

2.4.1 Manage work plan, human resources, clerk works and budgetary;

2.4.2 Security;

2.4.3 Office's infrastructure.

2.5 For operating work, Secretary of the Sub-Committee will act as a Manager under supervision of a Chairman of the Sub-Committee who is an Executive Director of the center;

2.6 Responsible for other assignments given by Chairman of the Committee on Study of Disaster Early Warning System.

2.7 Report outcome of works in 2.1-2.5 to Committee on Study of Disaster Early Warning System periodically;

Disbursement for per diem will be subject to the Royal Decree on Per Diem B.E. 2547 and will be borne by the Office of Prime Minister Secretary Office.

Effective as of today,

Dated of 8th April B.E. 2548

(Mr. Smith Dharmasaroja)
Vice Minister of Office of Prime Minister
Chairman of a Committee on Study of Disaster Early Warning System

In addition, there are seven other sub-committees; namely, Study and Develop of Telecommunication System for Early Warning; Audio-Visual; Establishing of Warning System in the Risk Areas; Geographical Information System; Water disaster, Meteorology and Forest Fire Warning; Earthquake and Tsunami Warning; and Floods Warning.

NDWC is now proposing the Office of Prime Minister Regulation for having a cabinet resolution. The Regulation will be temporary used as a legal entity for NDWC to mobilize its early warning arrangement. In the near future, NDWC will have its own Royal Decree under the Civil Disaster Prevention Acts B.E. 2522 (1979). Then, NDWC

will be an organization under the Secretariat of the Prime Minister, Office of Prime Minister.

2B: NATIONAL PLATFORM FOR DISASTER REDUCTION

Question 3: *Does your country have a National Platform or other mechanism for guiding disaster risk reduction in general?*
Answer: Yes, there is a National Platform, chaired by the Prime Minister, for disaster emergencies under whose responsibility are all other committees for specific forms of disaster. Among them the National Disaster Warning Center (NDWC) and the Department of Disaster Prevention and Mitigation (DDPM).

Question 4: *With respect to tsunamis, for example, has your country established a National Tsunami Warning and Mitigation Coordination Committee or some other coordination mechanism?*
Answer: Yes, we have established a Committee on the Study of the Disaster Early Warning System and a Sub-Committee on the National Disaster Warning Center Administration. DDPM plays a role in coordinating actions with other departments involved.

Question 5: *Does your country have similar coordination mechanisms at the community level?*
Answer: Yes, we have through the Department of Provincial Administration and the DDPM, Ministry of Interior.

Question 6: *Who (types of persons and agencies) are members of this Committee?*
Answer: They are listed in answer of Question 2.

Question 7: *What authority does this Committee have (decision-making, policy-making, advisory (if yes, to whom), independent reporting to one agency, etc.)?*
Answer: The authorities are described in answer of Question 2.

2C: NATIONAL ORGANIZATIONS

Question 8: *What are the important organizations, both government and non-government, for the implementation of a tsunami early warning and mitigation system?*
Answer: Important government organizations are the National Disaster Warning Center (NDWC), as a core competent authority, Department of Mineral Resources, Hydrographic Department of the Royal Thai Navy, Meteorological Department and Department of Disaster Prevention and Mitigation (DDPM). For telecommunication, the Television Pool of Thailand is important as a central television and radio network system. For emergency response, the Department of Provincial Administration is also important. Non-governmental organizations are also important in giving support (i.e. funding). DDPM has a network of NGOs (e.g. Red Cross) to assist in relief and disaster mitigation that meets once a year.

Question 9: *What roles will they play? Please specifically include the roles, responsibilities and authorities of the National Meteorological Service and the National Disaster Management Organization, or their equivalent monitoring, warning evaluation, and warning dissemination agencies. These, in fact, may be the same as those that comprise your Coordination Committee above.*
Answer: NDWC will function as a national warning center in nation-wide early warning on severe disasters which will affect human lives and properties. This means that NDWC will be in-charged of warning operation, monitoring, evaluation, dissemination of warning messages and coordinating with Department of Disaster Prevention and Mitigation and Department of Provincial Administration in local incident management. Meteorological Department will be responsible for general weather forecast and earthquake information. Department of Disaster

Prevention and Mitigation will have major responsible in implementing preparedness, response and recovery in collaboration with Department of Provincial Administration. The Committee and Sub-committees are established mainly for interim study and early development.

2D: PRIORITIES

Question 10: *What are your priorities for implementation of an effective tsunami warning and mitigation system? For example, by topic and sub-topic (assessment, warning, emergency response/preparedness/awareness, public/government or technical capacity-building, etc), by level (national, province, community, individual), by urgency (urgent, short-term, long-term, and time frame for action).*

Answer:

- Information (for assessing risk) (1)
- Dissemination (2)
- Coordination (3)
- Standard Operational Procedures (4)
- Training and Education (5)

After the Sub-Committee on NDWC Administration has been established on February 21st, 2005, a Chairman of the Sub-Committee as well as Executive Director of NDWC has established a Task Force consisting of staff members from the Supreme Commander Headquarters, technical departments, and from the Designated Areas for Sustainable Tourism Administration to initiate concept and strategic planning in operating early warning system for Thailand, to gather of information, and to obtain knowledge from local experts and experts from foreign competent agencies such as Pacific Disaster Center and Japan Meteorological Agency. The Task Force has successfully built up a comprehensive operating procedures emphasis on earthquake and tsunami which is now being used in the operation center of NDWC.

NDWC has officially been established on May 30, 2005. Most of Information, telecommunication and Technology were donated by private sectors both inside and outside Thailand. NDWC has been operating on a 24 hours times 7 days basis since then. The priorities of the Center for implementation of an effective tsunami warning and mitigation system are as follows:

1) Trainings, Workshops and Technical Capacity Building for NDWC staff

Activities	Time	Place	Participants
1) UNESCO/IOC Meeting on Establishment of Tsunami Early Warning System in the Indian Ocean, Paris, France	3-8 March 2005	Paris, France	Mr. Siri
2) Formulation of a Task Force for planning on establishing the early warning system and implementation from technical departments, Supreme Commander Headquarters, Designated Areas for Sustainable Tourism Administration	21 March-30 May 2005	CAT Telecom,BKK	40
3) Expert Consultation on NDWC Administration by Mr. Jim Buika, Senior Manager, Pacific Disaster Center, U.S.A.	31 March-1April 2005	CAT Telecom, BKK	60
4) Second International Coordination Meeting for the Development of a Tsunami Warning and Mitigation System for the Indian Ocean Port Louise, Mauritius	14-16 April 2005	Mauritius	Col. Anutat
5) Training on Early Warning Instrument by Ms. Lesley Cain, Dialogic Communications Cooperation, Hewlett Packard	20-21 April 2005	CAT Telecom, BKK	15
6) Tsunami Early Warning System Workshop	23 May 2005	NDWC	60

by Dr. Masahiro Yamamoto, Japan Meteorological Department, Japan			
7) Table Top Exercise and Conducts and Emergency Management by Experts from PDC, U.S.A.	24 May-6 June 2005	NDWC	60
8) Asia Pacific All Hazards Workshop by USTDA/NOAA	6-10 June 2005	Honolulu, U.S.A.	ACM Anubhund Col. Anutat
9) Workshop on SOP-Earthquake and Tsunami	13-17 June 2005	NDWC, Thailand	50
10) Site Visit to Phuket and Phang Nga for SOP Formulation	16-17 June 2005	Phuket, Phang Nga	15
11) Workshop on SOP-Collapse of Dam	20-24 June 2005	NDWC, Thailand	50
12) 23rd Session of the IOC Assembly Paris, France	21-30 June 2005	Paris, France	Col. Anutat
13) Workshop on SOP-Tropical Storm	27 June-1July 2005	NDWC, Thailand	50
14) Workshop on SOP-Severe Floods	4-8 July 2005	NDWC, Thailand	50
15) Workshop on Operation Plan for Emergency Management by DDPM	7 July 2005	Rama Garden Hotel Thailand	Mr. Suwit
16) Study Tour on National Tsunami Warning System Implementation in Japan	11-14 July 2005	Japan.	Mr. Smai
17) Workshop on SOP-Landslides	11-15 July 2005	NDWC, Thailand	50
18) Workshop on SOP-Wild Fires	18-20 July 2005	NDWC, Thailand	50
19) Meeting of Experts on Space Applications for Disaster Management, Chiang Mai UNESCAP	25-28 July 2005	Imperial Mae Ping Chiang Mai Thailand	Mr. Smai
20) Generation of Tsunamis and Possibility of Tsunami Monitoring using Marine Subsurface Sensors by Prof. Hitoshi Mikada, Kyoto University	28 July 2005	GISDA, Thailand	Mr. Tawan
21) Workshop on SOP-Pollution (Air, Water, Oil Spill)	25-29 July 2005	NDWC, Thailand	50
22) Study Tour on National Tsunami Warning System Implementation in Hawaii, U.S.A.	26-29 July 2005	Hawaii, U.S.A.	Dr. Cherdsak
23) U.S. Disaster Management Study Tour	27 July-1 August 2005	Hawaii, U.S.A.	Dr. Plodprasop
24) Workshop on NDWC Early Warning System	15-30 August 2005	NDWC, Thailand	50
25) The Asia United Nations Disaster Assessment and Coordination Induction Training Course at Singapore Civil Defense Training Academy	21 August-2 September 2005	Singapore	Mr. Tinnakorn Ms. Tamonwan

2) Emergency Response/Preparedness/Awareness

From December 26, 2004 to 31 July 2005, there were earthquakes of >5 Richter in the sea in the watching areas at the Northern Sumatra, the Nicobar and Andaman Islands approximately 656 times (5.0-6.0 Richter-621 times, 6.1-7.0 Richter-31 times, 7.1-8.0 Richter-2 times and 8.1-9.3 Richter-2 times). NDWC operation center has followed the Standard Operating Procedures developed at the Center in assessment and issuance of early notification without mistakes. The messages were disseminated to VIP, rescuers and media within 30 minutes. Emergency response and preparedness were coordinated with Department of Disaster Prevention and Mitigation and Department of Provincial Administration at the provincial and community levels. Awareness was made nation-wide through media interview both TVs, Radios and newspapers. Certain materials such as evacuation maps, risk maps and extension materials are made by Department of Mineral Resources and will be published by NDWC.

3) Future development of the early warning system

NDWC is now in a process to plan for a better architectural design of the early warning system based upon existing system and adaptive learning capacity and management. This is to integrate both emergency management (legal, organization, administration, geographical information system, media, public education, community outreach, center of excellence) and integrated information technology. NDWC will cooperate with national competent agencies in the Indian Ocean and Southeast Asia to exchange of information and technical cooperation. NDWC will have certain types of devices which can detect earthquake and tsunami on a real time basis. This will allow NDWC to make decision within 10 minutes and to issue warning

messages within the world standard timeframe and accuracy. When there are adequate database, NDWC will have capability to simulate data to obtain estimate time arrival of tsunami and its impacts. NDWC will do as much as possible to ensure that it will be 100% safe from tsunami disaster for Thai and foreign visitors.

In addition, TMD will upgrade seismic monitoring network throughout the country. The new digital network of 45 seismic stations will be completed in 2007.

Question 11: *What major activities are currently taking place to address these priorities?*
Answer: As shown in table of activities.

2E: INTERNATIONAL STANDARDS ASSISTANCE

Question 12: *Do you require assistance to harmonize existing standards and protocols in data collection, evaluation, and warning communication with those utilized by the global system to ensure interoperability?*
Answer: Yes, we do.

2F: REGIONAL COOPERATION – EARLY WARNING

Question 13: *Does your country currently cooperate with any neighbouring country when evaluating earthquakes and monitoring tsunamis in real time, or for tsunami warning services, or other mitigation activities? If yes, please describe recent activities and the nature of the cooperation.*
Answer: Yes, we do. We received tsunami watch information from JMA and PTWC. We sent letters to the Indian Ocean Countries and Southeast Asian Countries to request names, addresses, mobile phones, e-mails of key persons responsible for tsunami warning system in their countries. So far, we obtained information from Indonesia, Malaysia, and Sri Lanka.

Next activities will involve exchange of information and cooperation in evaluating earthquake, monitoring of tsunamis in real-time and technical training arrangement.
These include:
(1) Indonesia
Dr. Idwan Suhardi
e-mail: idwan@ristek.go.id
Mobile: +62-812-8765890
Dr. Pariatmono Sukamdo
e-mail: mono@bppt.go.id, pariatmono@yahoo.com
Mobile: +62-812-9079532
Gedung I BPPT lantai 11
JI. M. H. Thamrin 8, Jarkata 10340, Indonesia
Duty Officer tel. +62-21-65866502

(2) Malaysia
Seismological Division
Tel. 603-79550419, 603-79550534, 603-79584834
Mr. Low Kong Chiew
Mobile: 6012-2714943
e-mail: kclow@kjc.gov.my

(3) Sri Lanka
Mr. GHP Dharmaratana, Director General of Meteorology
Tel. 2694104 (Office), 2856358 (Residence), 07773057775 (Mobile)
Mr. Sarath Weerawarnakula, Director of Geological Survey
Tel. 2725745 (Office), 0382291225 (Residence), 0777515788 (Mobile)

Mr. Lalith Chandrapala, Deputy Director, Meteorology
Tel. 2665088 (Office), 2701694 (Residence), 0777391366 (Mobile)
Duty Officer at Early Warning Center
Tel. 2684746

The most recent one, we received earthquake information of 7.0 Richter occurred at the Nicobar Islands on July 24, 2005 and assessment by fax from Malaysian Meteorological Service, Ministry of Science, Technology& Innovation (Tel 603-79678000, e-mail cfo@kjc.gov.my) on July 25, 2005 at 12.05 am (Thailand).

2G: REGIONAL COOPERATION – ASSESSMENT AND MITIGATION

Question 14: *Does your country participate in any regional partnerships for assessing and responding afterward to earthquake and/or tsunami disasters? If yes, please describe.*
Answer: Yes, we did. Please look at the table of activities.

2H: RESEARCH EXPERTISE

Question 15: *Does your country have active researchers in seismology or tsunamis? If yes, please describe recent activities.*
Answer: Yes, we have. Department of Mineral Resources is carrying out research of inland earthquake sources and tectonic movement, Meteorological Department research on earthquake database and Asian Institute of Technology research on data simulation, modeling and impacts. Department of Marine and Coastal Resources is also carrying out research on impacts of Tsunami of December 26, 2004 on coral reefs and coastal areas. Geo-Information and Space Technology Development Agency is carrying out research on mapping of Tsunami impacts areas.

Question 16: *Does your government have a government-sponsored research organization that can provide products or services to strengthen your tsunami warning and mitigation system?*
Answer: Yes, we have such as the Thailand Research Fund, Office of Prime Minister.

SECTION 3: TSUNAMI WARNINGS AND TSUNAMI MONITORING

Scope: Please outline your country's situation regarding tsunami warnings and tsunami monitoring. Below are some questions that should be considered in providing a description.

3A: RECEPTION OF WARNINGS FROM INTERIM SYSTEM

Question 17: *Does your country currently receive international tsunami warnings for teletsunamis from the Pacific Tsunami Warning Centre and/or from the Japan Meteorological Agency?*
Answer: Yes, NDWC gets data from both agencies.

Question 18: *If yes, by what method and who receives it?*
Answer: NDWC receive fax and internet from PTWC and JMA. TMD receives message from PTWC by email, and from JMA through fax and GTS.

NDWC receives them through e-mail : plodprasop.s@dasta.or.th, ndwc_th@yahoo.com, ndwc@hotmail.com, and through facsimile No. +66-2-5896008 in the operation center of NDWC.

Question 19: *Is there a back-up, or alternative method, for receiving the warning messages?*
Answer: Yes, by phone. At PTWC, 808-6898207, e-mail: ptwc@ptwc.noaa.gov
At JMA, +81-3-32114966, e-mail: io_twi@eqvol.kishou.go.jp, inad_jma@hq.kishou.go.jp,

masahiro.yamamoto-a@met.kishou.go.jp. TMD hotline 6623990969

Question 20: *Does this agency provide 24-hours-a-day, 7-days-a-week services?*
Answer: **Yes, 15 person shift in 3 shifts.**

Question 21: *If your country does not currently receive international tsunami warnings for teletsunamis from the Pacific Tsunami Warning Centre and/or from the Japan Meteorological Agency then would your country like to receive these and by what method? Available methods include e-mail, fax, EMWIN, GTS (Global Telecommunications System with WMO headers), AFTN/NADIN.*
Answer: NDWC does not have EMWIN, GTS, AFTN/NADIN. TMD gets through GTS.

3B: NATIONAL TSUNAMI WARNING CENTRE

Question 22: *Does your country operate, or intend to operate, a national or regional tsunami warning center to monitor and warn of regionally- or locally-generated tsunamis?*
Answer: Yes, we do operate a warning center at the national level.

Question 23: *If yes, please provide information on the system (data networks, evaluation methods, and message dissemination processes).*
Answer:

- NDWC receives earthquake and sea level information from related Government agencies including Meteorological Department of Mineral Resources, Hydrographic Department of the Royal Thai Navy, Disaster Prevention and Mitigation Department, Electricity Generating Authority of Thailand, and Royal Irrigation Department
- The Center receives information from Hot line and e-mail on a 24-hour basis, 30 lines Call Center with Hot-line No. 1860, and checking of information through related websites.
- NDWC receives the earthquake information from international and regional centers such as the Pacific Tsunami Warning Center (PTWC) in Hawaii, U.S.A., Japan Meteorological Agency (JMA) in Japan, Seismic Earthquake Detection/Warning Network, United States Geological Surveys (USGS), European-Mediterranean and Seismological Center (EMSC), Indonesian Meteorological and Geological Agency (IMGA), and Malaysian Meteorological Service (MMS), etc. Within the country this information is provided by TMD who process the data from seismic stations in Thailand.
- The information will be used for data analysis and simulation for decision by experts of NDWC. Executive Director will make decision based on pre-determined criteria in the Standard Operating Procedure (SOP) see attached. Issuance of warning message will be given in according to levels of severity (advisory, watching and warning).
- Output notification messages (see attached) will be issued through SMS, e-mail, facsimile transmission, radios and TV pool from the Center broadcasting Studio.

The early warning system diagram is described below:

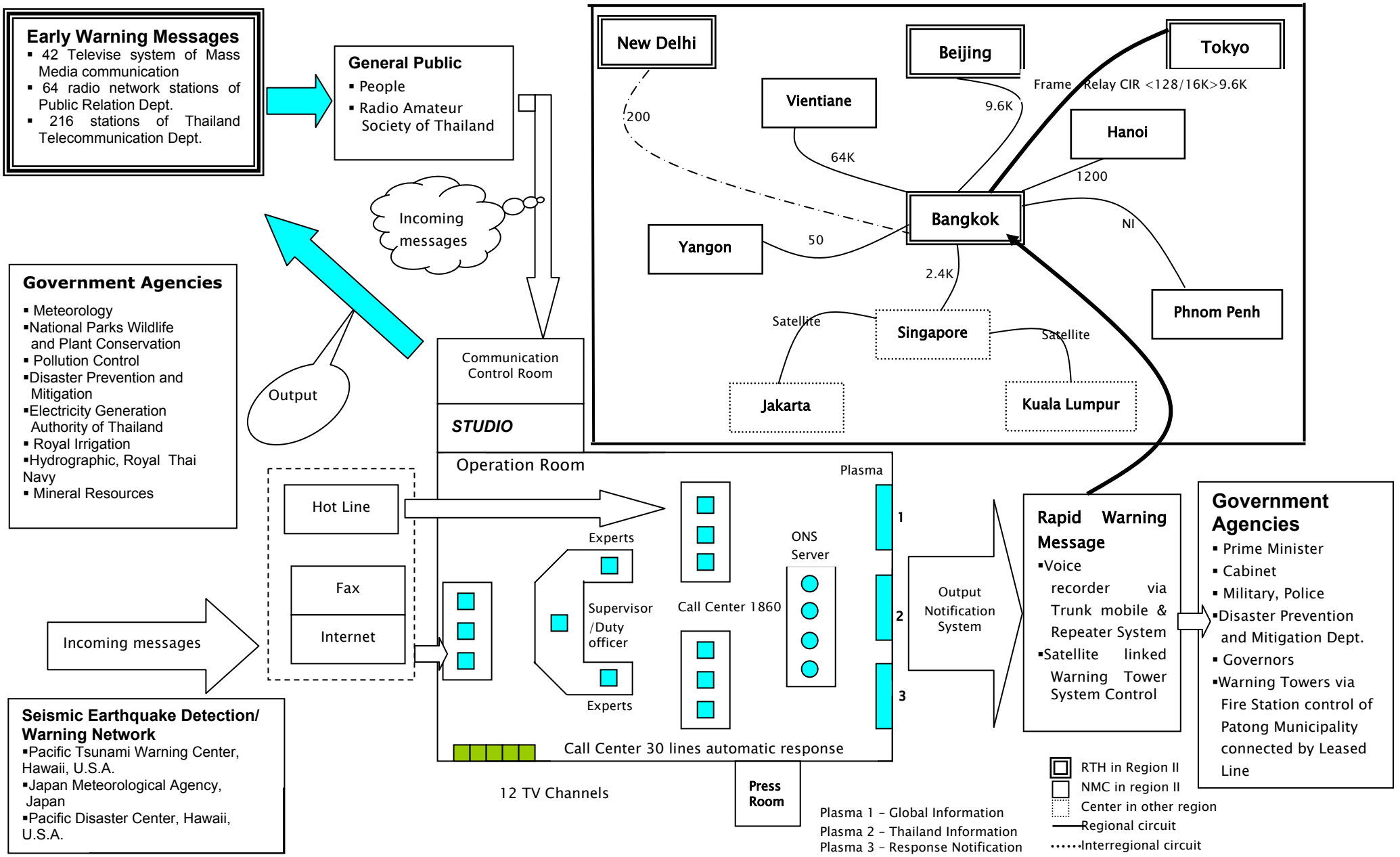


Diagram of Early Warning System at National Disaster Warning Center, Thailand

Question 24: *Does the warning center have staff that are always present in the operations center 24-hours-a-day, 7-days-a-week, or are staff on an on-call basis through automated processes which notify the on-duty staff through a phone message or pager?*
Answer: Yes, we do.

3C: TSUNAMI WARNING ALARM INFRASTRUCTURES

Question 25: *Does your country use alarms and other types of paging systems to notify staff of tsunami alarm events?*
Answer: We normally disseminate alerting notification through SMS, fax and e-mail for notifying NDWC staff, VIP, and rescuers. For alarming, we have installed three warning towers at the Patong Beach in Phuket. Some 62 warning towers are going to be installed to cover risk areas in all six provinces. In addition there are plans to set up people alarm network.

Question 26: *Are these dedicated notification systems, or do they use commercial services?*
Answer: They are both dedicated (TV, radio, hot-line, warning towers) and commercial services (SMS, fax, email).

Question 27: *If so, who is notified, and does this include both warning centre staff and emergency response officials?*
Answer: Prime Minister, Ministers responsible for emergency arrangement, Governors, District Officers, and Village leaders are notified. Yes, these include both warning center staff and emergency response officials.

3D: SEISMIC NETWORK

Question 28 : *Does your country operate any seismographic stations or seismograph networks to monitor regional seismicity?*
Answer: Yes, we do. TMD operates seismographic stations and provide processed seismic parameters to NDWC.

Question 29: *If yes, please describe the system or institution, including location, instrumentation and telecommunications and analysis.*
Answer: At present, the Meteorological Department has its seismograph network system as follows: 8 digital stations link to TMD via VSAT. Earthquake parameters are calculated by offline analysis.

Provinces	Types	
	Analog	Digital
Chiangrai	* (1 SP)	* (1 SP)
Chiang Mai		* (1 SP, 1 BB)
Lam Pang		-
Mae Hong Son	* (1 SP)	
Prae	-	* (1 BB)
Nan	* (1 SP)	* (1 SP)
Phumiphon Dam, Tak	* (1 SP)	* (1 SP)
Ubonratchathani	* (1 SP)	-
Loei	* (1 SP)	* (1 SP)
Nakorn Sawan	* (1 SP)	-
Kao Laen Dam, Karnchanaburi	* (1 SP)	-
Sri Nakarin Dam, Karnjanabur i	-	* (1 BB)
Chantaburi	* (1 SP)	-
Prajuabkirikhan	*(1 SP)	
Songkhla	* (1 SP)	*
Phuket	* (1 SP)	-
Khonkaen	* `	

SP: Short period
BB: Broadband

Question 30: *Are the data available in real-time in your center?*
Answer: Not at present but it is planned to access in the near future from TMD to NDWC.

Question 31: *Can you provide these data in real time and how?*
Answer: Not at present but it is planned to provide in the near future from TMD.

Question 32: *Does your country operate any seismographic stations or seismograph networks to monitor local seismicity?*
Answer: Yes, TMD uses VSAT and land lines to transmit data from seismographic stations to the Meteorological Department HQ, on a near real time basis. The Meteorological Department has evaluated several potential sites for installation of additional seismographic stations. There are 45 new digital types to replace the existing stations and install a new remote sits to enhance capacity of monitoring,.

3E: UTILIZATION OF SATELLITE SYSTEMS FOR MONITORING, DATA COLLECTION AND DISSEMINATION (WMO)

Question 33: *Is your country aware of the satellite capabilities offered through different countries in the region?*
Answer: Yes, we are aware of the satellite such as the IMMARSAT.

Question 34: *What is the current capacity (equipment to receive, technical ability to access and interpret, etc) of your country in utilizing satellites for hazard monitoring, data collection and exchange?*
Answer: The current capacity is within the Meteorological Department mostly for earthquake and weather monitoring and data collection. Other capacity exists in GISTDA for receiving and using remote sensing information.

Question 35: *Please describe through which satellite systems you are receiving data? What kind of data and how*?
Answer: TMD utilizes data through V-Sat system to link up seismic stations to its HQ in Bangkok. In addition, other satellites such as LANDSAT, IKONOS, GMS, METEOSAT are used for satellite imagery and information.

Question 36: *What are the major obstacles faced by your country with respect to the use of satellites for hazard monitoring, data collection and exchange? If they are not used, please specify why (lack of technical expertise, lack of funds, lack of equipment, or other reasons).*
Answer: The Meteorological Department lacks technical expertise and maintenance programme. It, normally, obtains consultancy from private company such as Siam Sat for data synthesis. Lack of budget is one of the major obstacles. Right now the department rents satellite signal for 8 seismic stations.

The other problem is that the contract end dates for earthquake monitoring maintenance and rental of time of VSAT communications terminate in different months, the result of which there will be a gap to operate systems continuously.

3F: SEA LEVEL NETWORK

Question 37: *Does your country operate any sea level stations (coastal or deep-ocean instruments) to monitor sea level?*
Answer: Yes, we do. We currently have four coastal gauge stations under responsibility of the Hydrographic Department of the Royal Thai Navy at Koh Miang,

Phang Nga (1),
Tab Lamu, Phang Nga (1),
Tapao Noi Island, Phuket (1) and
Koh Tarytao, Satoon (1).

Other five stations with real-time capability will be installed in
Ranong (1),
Surin Islands, Phang Nga (1),
Koh Racha Noi, Phuket (1),
Trang (1) and
Satoon (1).

TMD has already got national budget to purchase deep sea oceans gauges.

Question 38: *Are these stations available real-time to the central monitoring site, or available in near real-time to the PTWC/JMA for use in the IOTWS?*
Answer: They are not real-time, except for one at the present time located at off the west coast of Phang Nga. There is a plan to upgrade all existing stations into real time.

Question 39: *Do these stations sample sea levels frequently enough and transmit their data frequently enough to resolve short-wavelength tsunami (e.g. do they sample at 1 min or less intervals, and transmit their data every 15 minutes or less to a central site or by satellite)?*
Answer: They are sampled every two minutes, but report will be made as required.

Question 40: *If yes, please describe the system or institution, including location, instrumentation and telecommunications and analysis.*
Answer: Information available and to be provided.

Question 41: *If other digital data are available in your center, can you provide these data to the PTWC/JMA?*
Answer: Yes, we can.

3G: INTERNATIONAL COORDINATION

Question 42: *Are there international agencies, besides the IOC of UNESCO, or through bilateral or other assistance, any countries, universities or other technical institutions that you are coordinating, working with, or who are providing services to strengthen your tsunami monitoring, evaluation, warning capabilities?*
Answer: These include Pacific Disaster Center in Hawaii, U.S.A., United States Trade and Development Agency, Japan Meteorological Agency, Malaysian Meteorological Service, Indonesian Meteorological and Geophysical Agency, Sri Lanka Meteorological Service, International Ocean Institutes in Malta and Australia.

SECTION 4: TSUNAMI WARNING RESPONSE AND EMERGENCY PREPAREDNESS

Scope: Please describe your country's situation regarding tsunami warning response and emergency preparedness. Below are some questions that should be considered in providing a description.

4A: WARNING DISSEMINATION AGENCY

Question 43: *Who is the designated agency for receiving and acting upon the tsunami advisory message from the tsunami warning center?*

Answer: Department of Disaster Prevention and Mitigation (DDPM) and Department of Provincial Administration are the designated agencies for receiving and acting upon the tsunami advisory message from NDWC.

Question 44: *Does this agency have authority by law?*
Answer: Yes.

Question 45: *Does this agency issue public evacuations?*
Answer: Yes. Evacuation orders are handled by Provincial Governors in coordination with DDPM and all departments involved. DDPM has twelve regional centers that coordinate with provinces.

Question 46: *If not, who are the responsible agencies?*
Answer: --

4B: CAPACITY-BUILDING ASSESSMENT

Question 47: *Have you assessed your existing disaster management system and identified the requirements of individuals and institutions for training and capacity-building?*
Answer: Yes, we have assessed. This process has been documented and is available under DDPM. DDPM has an Academy with functions in training operational people at regional, provincial and local level. Training of trainers approach is utilized.

4C: TSUNAMI RESPONSE PROCEDURE (DISTANT OR REGIONAL TSUNAMIS)

Scope: After receiving an international tsunami advisory message (distant tsunami), what are the procedures for responding? Response procedures should typically answer the following questions:

Question 48: *What criteria are used by the designated emergency authority to determine whether an evacuation should be issued, i.e. how is the science-based tsunami warning message translated into public guidance?*
Answer: When it is indicated that there is earthquake in sea area in watching areas with magnitude more than 7.0 Richter (see figures below), supervisor will consult with experts of command center to confirm the case. Then supervisor will command output officer to inform warning towers for preparation and officers at the Similan Island to monitor closely sea level change.

For the warning criteria, Supervisor will use information as specified in facsimile to broadcast through TV channel 5. It shall be broadcasted every 5-10 minutes until estimate time of arrival (ETA) has reached at the last location.

Inform Executive Director, Vice Executive Directors and all people concerns as listed through telephone and SMS and inform officers at the warning towers to activate sirens for evacuation of people from the risk areas.

Also provide warning by radio communication system of the Department of Provincial Administration to Governors in six coastal provinces and authorities concern on time available before tsunami arrival time and inform them of evacuation.
Governors and authorities will proceed for provincial evacuation plan which have been exercised in each specific risk areas.

Earthquake Magnitude and Radius of Effective Area

Distant (Km) / Magnitude (Richter)	0-24	25-48	49-112	113-200	201-400	401-720
3.0-3.9	Advisory	Advisory	Advisory	--------	--------	----------
4.0-4.9	Warning Low Risk	Advisory	Advisory	Advisory	Advisory	----------
5.0-5.9	Disaster	Warning High Risk	Warning Low Risk	Advisory	Advisory	Advisory
6.0-6.9	Disaster	Disaster	Warning High Risk	Warning Low Risk	Advisory	Advisory
7.0-7.9	Disaster	Disaster	Disaster	Disaster	Warning High Risk	Warning Low Risk
8.0-8.9	Disaster	Disaster	Disaster	Disaster	Disaster	Warning High Risk
> 8.9	Disaster	Disaster	Disaster	Disaster	Disaster	Disaster

Criteria of Tsunami

Magnitude	Depth of Hypocenter	
	less than 100 km.	more than 100 km.
5.0-6.4	Low possibility to generate Tsunami Advisory	Low possibility to generate Tsunami Advisory
6.5-6.9	Possibility to generate Tsunami Alert / Watching	Low possibility to generate Tsunami Advisory
7.0-7.7	High possibility to generate Tsunami Alert / Watching	Possibility to generate Tsunami Alert / Watching
> 7.8	Very high possibility to generate Tsunami Warning	High possibility to generate Tsunami Alert / Watching

Question 49: *How is that information disseminated to the public? Are there sirens, or other emergency broadcast methods for immediately broadcasting warning messages? Are these all-hazard, specific to a certain hazard, or tsunami-specific? If an early warning notification system exists to alert communities, please briefly describe.*

Answer: Information, Advisory, Watching and Warning will be disseminated to the public by televisions, radios and sirens. These are designed for all hazards, but warning towers are designed specifically for tsunami.

Three of them are already installed and the system is planned for 62 sirens in 6 southern provinces on the Andaman side.

Question 50: *Are there marine warnings, and is there guidance or instructions for marine vessels, harbours and ports?*
Answer: Yes, we have emergency plans, tsunami evacuation plans and signage indicating evacuation routes to safety grounds.

Question 51: *When an evacuation is issued, is the public required by law to evacuate or is it an evacuation advisory only?*
Answer: Yes, recommendation is to have marine vessels move offshore. For harbors and ports arrangement, they will follow evacuation plans set forth by Department of Provincial Administration, Department of Disaster Prevention and Mitigation, the Royal Thai Navy and Department of Fisheries' Coastal Radio Stations.

Question 52: *When an evacuation is issued, is the public required by law to evacuate or is it an evacuation advisory only?*
Answer: The evacuation advisory is not enforced by law.

Question 53: *Are there procedures or criteria for when it is safe for responders or the public to return*
Answer: Yes, there will be termination notification issued by NDWC through TV and radios.

4D: ISSUANCE OF WARNINGS FOR MARINE SAFETY

Question 54: *Does the National Meteorological and Hydrographical Service (NMHS) have a mechanism for warning mariners (e.g. communication system NAVTEX, access to INMARSAT Safety-Net)? Please specify current capabilities.*
Answer: The Meteorological Department and NDWC issues warning messages through televisions, radios, and newspapers. Whereas, the Royal Thai Navy has its systematic procedures of detecting an abnormal signal of the dynamic level of water gauges and report it through regional and local bases through their radio and microwave telecommunication.
These procedures are also done with computer system and manual verification.

Question 55: *Do the NMHSs issue marine forecasts and warnings (e.g. storm and gale warnings, weather bulletins, etc.) to the mariners and coastal zone users in their region, and how? (e.g. GMDSS fax, facsimile and radio, or other)*
Answer: Yes, they do by televisions, radios and newspapers.

Question 56: *How are the contents of the warnings for mariners formulated? Are these developed within the NMHS or in collaboartinon with other agencies? Please describe.*
Answer: In form of bulletin news. They are developed by the Meteorological Department.

Question 57: *Are these warnings effective and timely? What are the weaknesses associated with the current marine warning systems that you utilize in your organization?*
Answer: Yes, they are effective at certain level, but they need to disseminate information 4 times/day (06.00 am, 12.00 am, 05.00 pm and 11.00 pm).

Question 58: *In light of the short time window for tsunami warnings what are the strengths and weaknesses of the current warning mechanisms you utilize for issuance of warnings to mariners and coastal zone users? Do you need assistance in formulation of the warnings, enhancement of your communication mechanisms, or other subjects (please specify) to address specific requirements for tsunami warnings?*
Answer: The current warning system of NDWC, Thailand has its own broadcasting system which is a central command system. It has ability to communicate with mariners and coastal

zone users. Technical advice is needed to enable effective communication with small fishing boats, as well as project funding.

4E: DISSEMINATION PROCEDURE (LOCAL TSUNAMIS)

Question 59: *For the case of a regionally or locally generated tsunami, do you have procedures for responding?*
Answer: Yes, we have procedure for responding. Right now, the Standard Operating Procedure for Earthquake and Tsunami has been published (July version).

4F: DISSEMINATION PROCEDURE (EARTHQUAKES)

Question 60: *Does your country have response procedures for earthquakes? If so, do these include tsunamis?*
Answer: Yes, we have response procedure including tsunami.

4G: RESPONSE PROCEDURE DRILLS/EXERCISES

Question 61: *Are your procedures tested or exercised to improve the response through better planning and preparedness?*
Answer: Yes, they are tested to improve the respond through planning and preparedness.

Question 62: *If yes, please describe how this is done, who is involved, and whether it is done regularly.*
Answer: This is done as follows:
1) Exercise in the operating center everyday;
2) Coordinate with Department of Disaster Prevention and Mitigation to drill on evacuation of people;
3) Inform public using watching criteria on July 5, 2005 and 24 July 2005.

4H: CONSIDERATION OF CRITICAL INFRASTRUCTURE

Question 63: *Have you identified critical infrastructure and lifeline support facilities (hospitals, ports and marine facilities, land transportation, energy utilities, telecommunications, etc.) and made plans to ensure minimal government services after a destructive tsunami, or other natural disaster?*
Answer: Yes, the Royal Thai Government has identified critical infrastructure and lifeline support facilities. These are made through Department of Provincial Administration.

4I: OTHER LOCAL CONTACTS

Question 64: *Please provide local reporting contacts that the PTWC/JMA can contact during a tsunami alarm to confirm that a tsunami has occurred. Eyewitness observations or other local information are especially important for monitoring the destructiveness of the tsunami as it propagates across the Indian Ocean.*
Answer:

Provinces	Position	Mobile Ph.
1. Krabi	Governor	66-1-6162908
	Provincial Disaster Manager	66-9-9696717
2. Trang	Governor	66-9-9734227
	Provincial Disaster Manager	66-9-9696730
3. Satun	Governor	66-1-3700404
	Provincial Disaster Manager	66-9-9696774
4. Phang Nga	Governor	66-9-9734228
	Provincial Disaster Manager	66-9-9696749
5. Phuket	Governor	66-9-9734229

	Provincial Disaster Manager	66-9-9696759
6. Ranong	Governor	66-9-9734231
	Provincial Disaster Manager	66-9-9696746
7. Tidal Gauge at Koh Miang, the Similan Island, Phang Nga	Chief On-scene Officer Royal Thai Navy	66-76-417021
8. Warning Tower at the Patong Beach, Phuket	On-scene Officer Fire Station	66-76-342600

4J: POST-TSUNAMI SCIENCE SURVEYS

Question 65: *After a damaging earthquake and/or tsunami, does your country carry out post-event data surveys to assess damage and collect tsunami run-up/inundation data?*
Answer: Yes, we do.

Question 66: *If yes, what organization(s) usually carry out this task?*
Answer:
Ministry of Natural Resources and Environment consisting of

- Department of Mineral Resources
- Department of Marine and Coastal Resources
- National Parks, Wildlife and Plant Conservation Department

4K: INTERNATIONAL COORDINATION

Question 67: *Are there international agencies, besides the IOC of UNESCO, or through bilateral or other assistance, any countries or other institutions that you are coordinating, working with, or who are providing services to strengthen your tsunami warning response? If yes, please indicate who and describe the assistance.*
Answer: Yes, there are.

International Organizations/Institutions	Countries	Assistances
Asian Disaster Preparedness Center (ADPC) 29 March 2005	Thailand	Organize Regional Meeting on Needs Assessment for the Establishment of Early Warning for Tsunami and other Hydrometeorological Hazards
Asian Disaster Preparedness Center (ADPC) 20-21 April 2005	Thailand	2nd Experts Consultation Meeting for the Establishment of a Regional End-to-end Multi-hazard Early Warning System in Southeast Asia
Pacific Disaster Center 31 March-1 April 2005	U.S.A.	Expert Consultation on National Disaster Warning Administration
Boeing Autometric/PAR Government Systems Technology/Intermap/Sensor system/E-Team/ SeaSpace Technology Team 22 April 2005		U.S.A. Propose Tsunami Disaster Center Modeling, mapping, simulation, EM system, computer trainings for hospitals, schools, others
SiRCom & Kockum Sonics	Germany	3 Warning Towers
Finnish Institute of Marine Research, Vaisala Oyj 17 May 2005	Finland	Tidal Gauage System
SciTek Krungthep Co., Ltd & ZODIAC IN-SNEC, 20 May 2005	Thailand, France	Propose Tsunami Warning Coastal and Sea-floor mapping, GIS simulation, post-tsunami survey and satellite telemetry data linkage
Japan Meteorological Agency 23 May 2005	Japan	Tsunami Warning System
Pacific Disaster Center 24 May-6 June 2005	U.S.A.	Table Top Exercise and Conduct and EM Management

Hitachi Zosen Corporation 8 June 2005	Japan	Propose GPS Tsunami Observation System
United Nations Economic and Social Commission for Asia and the Pacific 22-24 June 2005		Organize High-level Expert Group Meeting on Technical Options for Disaster Management System: Tsunami and Others
United States Trade Development Agency United States Agency for International Development Agency 11-12 July 2005	U.S.A.	Technical assistance in gap analysis of existing resources and process, real time data collection capability, digital mapping, system integration, communication and notification, public education and community outreach
United Nations International Strategy for Disaster Reduction 20 July 2005	Switzerland	Technical assistance, trainings and community outreach
Pacific Disaster Center July 27-August 1, 2005	U.S.A.	United States Disaster Management Study Tour in Hawaii, U.S.A.

SECTION 5: TSUNAMI HAZARDS AND RISKS

Scope: Please describe your country's situation regarding tsunami hazards and risks, including tsunami numerical modelling. Below are some questions that should be considered in providing a description.

5A: TSUNAMI HAZARD STUDIES

Question 68: *Have studies been done to document the tsunami hazard in your country or region (either before or after 26 December 2004)?*
Answer: Yes, we have. Prior to 26 December 2004, there were quite limited studies on the tsunami hazard in Thailand. However, after the date, the Department of Mineral Resources has intensively carried out research studies to provide documentation such as inundation maps, evacuation maps, tsunami sedimentation, hazard assessment, risk assessment, and early warning system development.

A partial, but not complete list is as follows:

- Department of Mineral Resources, Ministry of Natural Resources and Environment. 2005. Geohazard "Tsunami" Earthquake of 9 Richter on December 26, 2004. 61 pp. (in Thai)
- Supharatit, S. (1998). Natural Disaster from Tsunami for Thailand. Journal of Engineering and Technology. Vol. 3(1): 15-19, Rangsit University, Pathumthani.
- Supharatit, S. and W. Udomdee. 1999. Thailand and Natural Disaster from Giant Wave. 5th Meeting of National Civil Engineering. p. 154-159.
- Supharatit, S. (2005). Tsunami: the Andaman Killer. 1st Series, Knowledge Base Requirement. 2004 Prepress Printing Co., Ltd. 96 pp. (in Thai)

Question 69: *Do you have a good historical record of past earthquakes and tsunamis?*
Answer: Yes, we have for earthquakes, if the form of historical records. We have plans to undertake paleo-tsunami studies in the Department of Mineral Resources.

Question 70: *If yes, please provide references to those studies.*
Answer: References can be searched from www.dmr.go.th and www.tmd.go.th.
(DMR=Department of Mineral Resources, TMD=Meteorological Department)

5B: TSUNAMI VULNERABILITY STUDIES

Question 71: *Have studies been done to identify vulnerabilities and then to document the tsunami risk in your country or region?*

Answer: Yes, we have. These have mainly been done after the Dec. 28, 2004, event. Initial inundation map was made.

Question 72: *If yes, please provide references to those studies, and generally describe your tsunami risks.*
Answer:
Department of Mineral Resources. 2005.
Geohazard "Tsunami" Earthquake of 9 Richter on December 26, 2004. Ministry of Natural Resources and Environment. 61 pp. (in Thai) GISDA. 2005.
Use of Geographical Information System to monitor affected Areas from Tsunami in Thailand. Geo-Information and Space Technology Development Agency. 82 pp. (in Thai)

5C: NUMERICAL MODELLING STUDIES

Question 73: *Have numerical modelling studies been done to calculate inundation from tsunamis in your country?*
Answer: Yes, they have been done by Department of Mineral Resources, Meteorological Department and NDWC, Thailand.
However, Thailand would welcome technical assistance from foreign experts in this task. We note that the collection of new high resolution bathymetric and digital elevation data is planned for this purpose.

Question 74: *If yes, please provide references to those studies and indicate where the studies were conducted.*
Answer: Studies can be referenced through website of Department of Mineral Resources. The study areas are in six coastal provinces affected by Tsunami.

Question 75: *If no inundation modelling has been done, does your country plan to do this in the future?*
Answer: Yes, we will do.

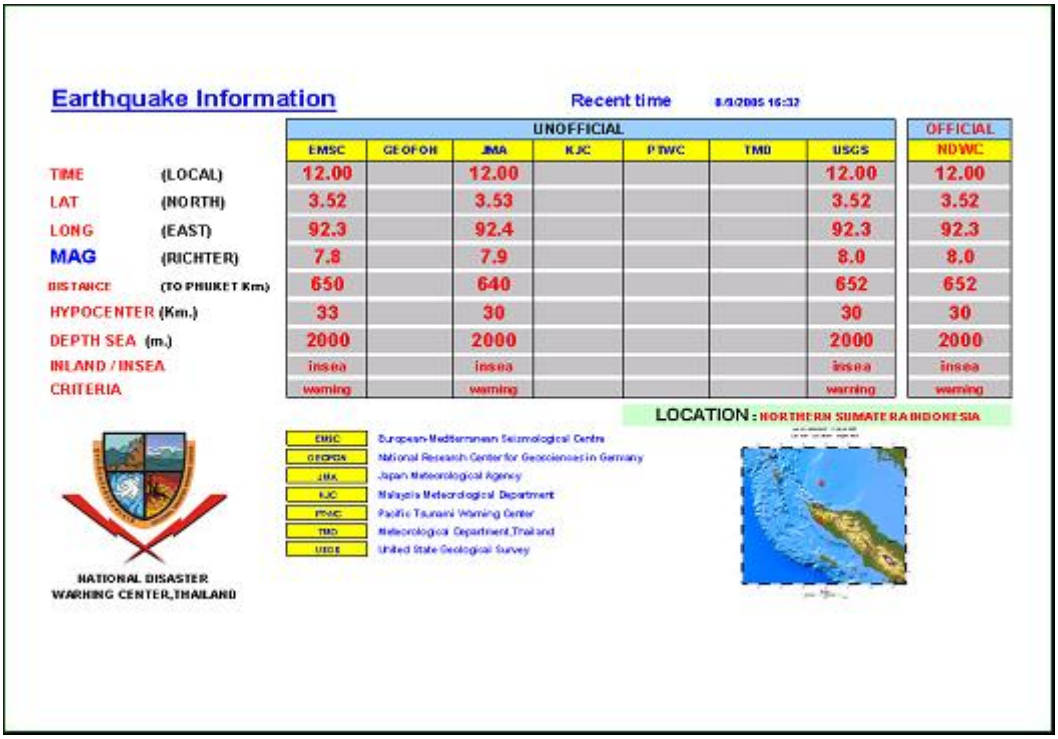
Question 76: *Is technical training required to build this capacity?*
Answer: Yes, it is required. As mentioned above, training will be welcomed.

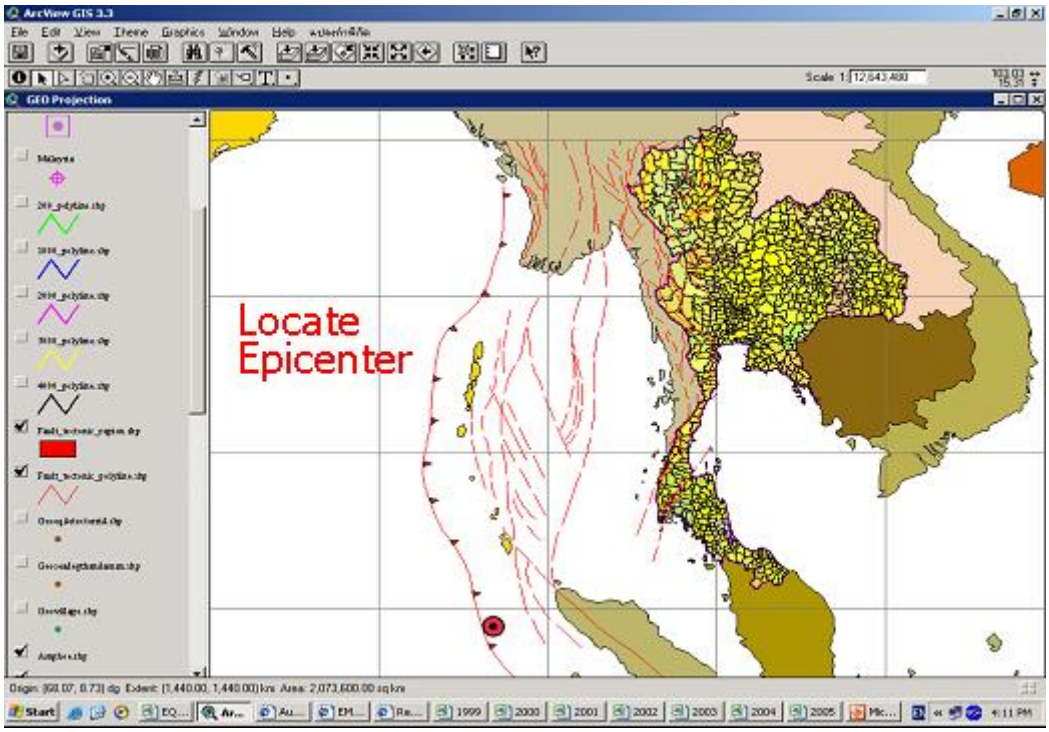
Question 77: *Does accurate bathymetry and topography data exist for the coastlines (30 m grid resolution or better), or does data need to be collected first?*
Answer: Data need to be collected first.

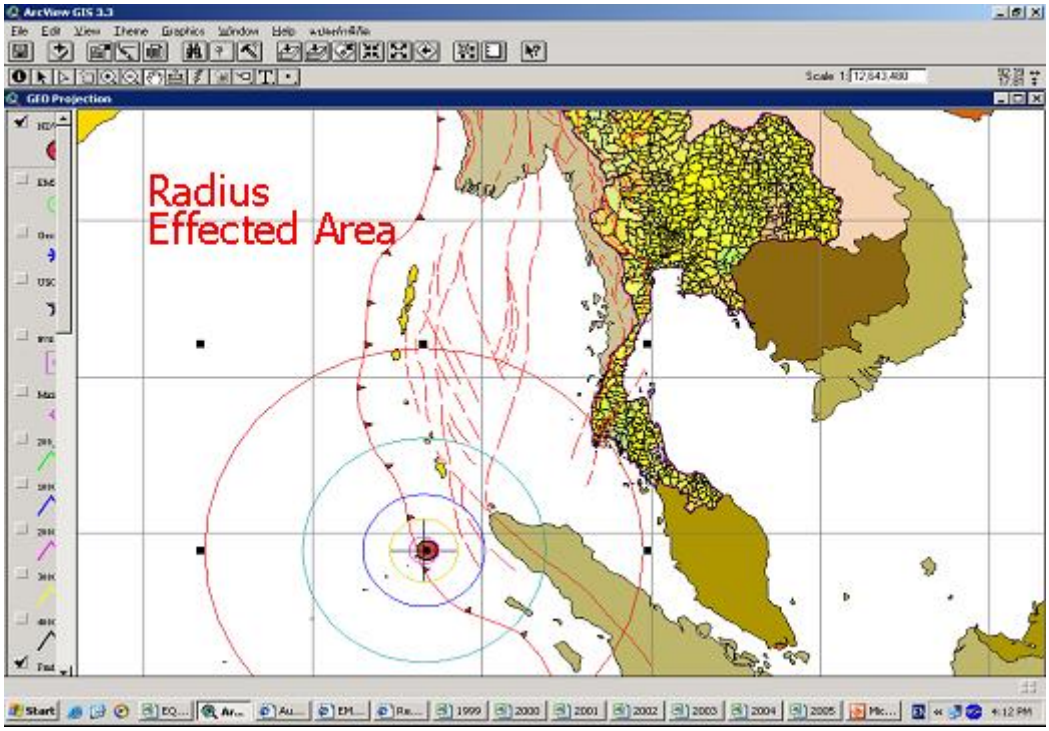
5D: GIS USE

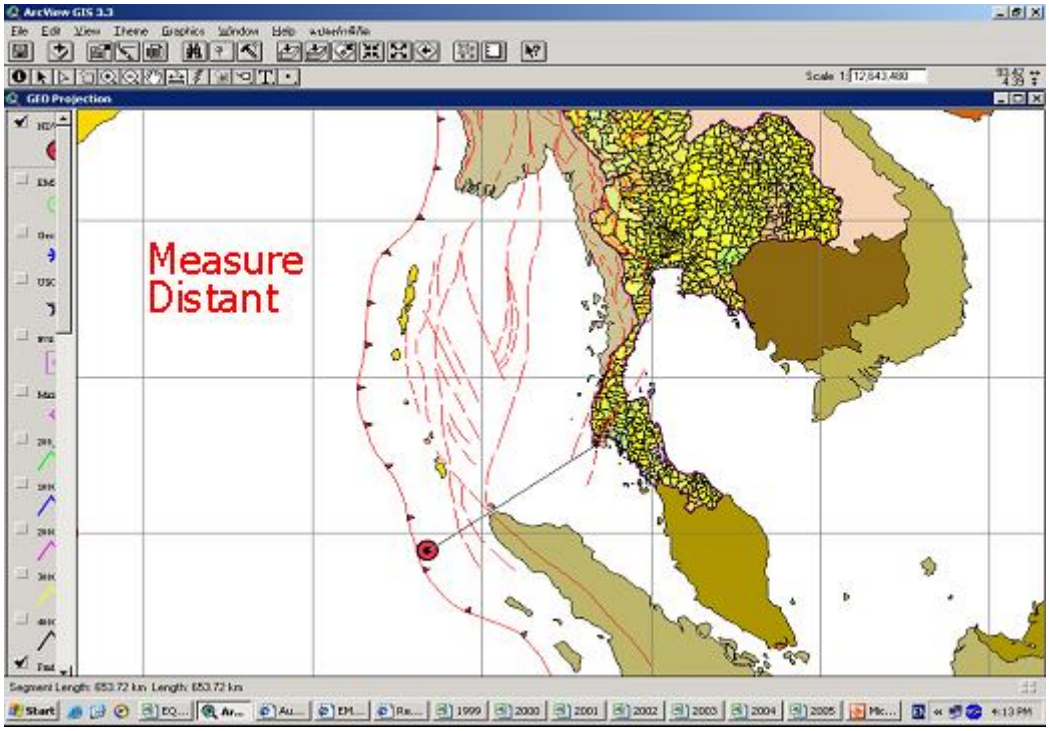
Question 78: *Are geographic information systems (GIS) used as a decision support tool during emergency response?*
Answer: Yes, GIS, remote sensing system and satellite imageries are used as a decision support tool during emergency response.

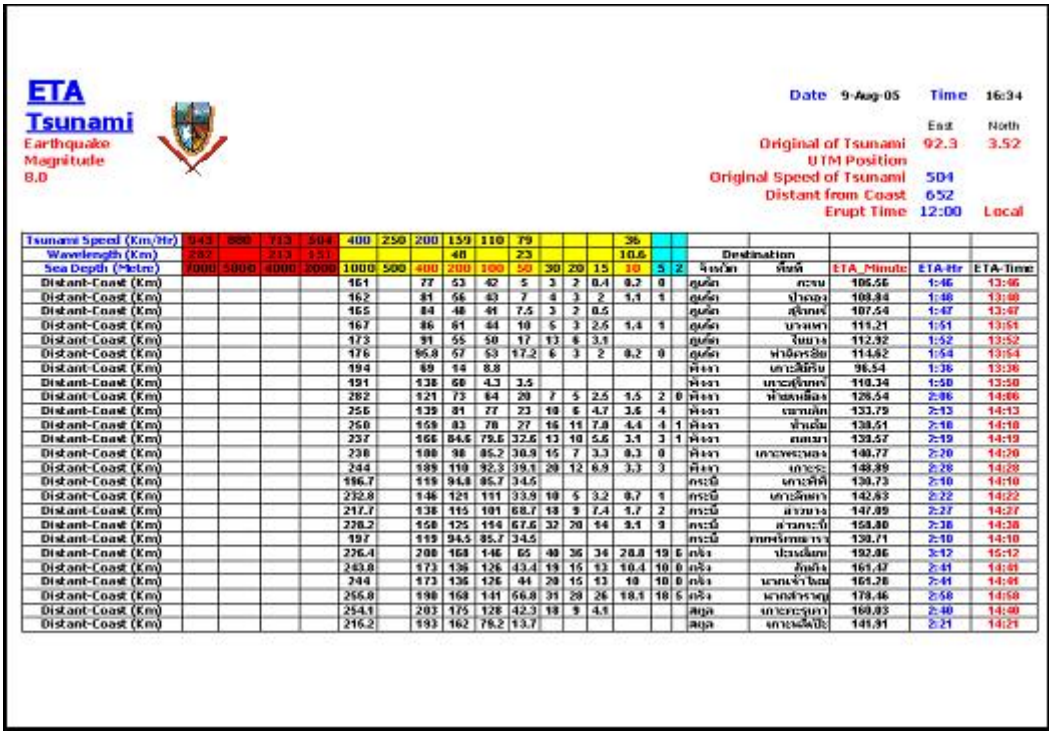
Question 79: *If yes, are building inventory, critical infrastructure, demographics, emergency response and evacuation, bathymetry and topography, tsunami, earthquake or other hazard or risk data layers available?*
Answer: Yes, some information is available such as evacuation maps, earthquake maps, topographic maps of 1:50,000 scale. Some data are now being processed.


Earthquake Information
Recent time
UNOFFICIAL
OFFICIAL
EMSC
GEOFON
JMA
KMC
PTWC
TMD
USGS
NDWC
TIME (LOCAL) 12.00 12.00 12.00 12.00
LAT (NORTH) 3.52 3.53 3.52 3.52
LONG (EAST) 92.3 92.4 92.3 92.3
MAG (RICHTER) 7.8 7.9 8.0 8.0
DISTANCE (TO PHUKET Km) 650 640 652 652
HYPOCENTER (Km.) 33 30 30 30
DEPTH SEA (m.) 2000 2000 2000 2000
INLAND / INSEA insea insea insea insea
CRITERIA warning warning warning warning
LOCATION : NORTHERN SUMATERA INDONESIA
EMSC European-Mediterranean Seismological Centre
GEOFON National Research Center for Geosciences in Germany
JMA Japan Meteorological Agency
KMC Malaysia Meteorological Department
PTWC Pacific Tsunami Warning Center
TMD Meteorological Department,Thailand
USGS United State Geological Survey
NATIONAL DISASTER
WARNING CENTER,THAILAND


ArcView GIS 3.3
GEO Projection
Locate
Epicenter


Radius
Effected Area


Measure
Distant



ETA
Tsunami
Earthquake
Magnitude
8.0

Date 9-Aug-05 Time 16:34

	East	North
Original of Tsunami	92.3	3.52
UTM Position		
Original Speed of Tsunami	504	
Distant from Coast	652	
Erupt Time	12:00	Local

Tsunami Speed (Km/Hr)	943	888	713	504	400	250	200	159	110	79				36			Destination				
Wavelength (Km)	787		713	151				48		23				10.6							
Sea Depth (Meter)	7000	5000	4000	2000	1000	500	400	200	100	50	30	20	15	10	5	2	จังหวัด	พื้นที่	ETA_Minute	ETA-Hr	ETA-Time
Distant-Coast (Km)					161		77	53	42	5	3	2	0.4	0.2	0		อุดร	กระบ	105.56	1:46	13:46
Distant-Coast (Km)					162		81	56	43	7	4	3	2	1.4	1		อุดร	ปากลอง	108.84	1:48	13:48
Distant-Coast (Km)					165		84	48	41	7.5	3	2	0.5				อุดร	สุไหงหงี	107.54	1:47	13:47
Distant-Coast (Km)					167		86	61	44	10	5	3	2.5	1.4	1		อุดร	บางเหรา	111.21	1:51	13:51
Distant-Coast (Km)					173		91	55	50	17	13	6	3.1				อุดร	จันยาง	112.92	1:52	13:52
Distant-Coast (Km)					176		95.8	57	53	17.2	6	3	2	0.2	0		อุดร	ฟาโตะรอีย	114.62	1:54	13:54
Distant-Coast (Km)					194		89	14	8.8								พังงา	เกาะมิเรีย	96.54	1:36	13:36
Distant-Coast (Km)					191		138	68	43	3.5							พังงา	บางสักขาว	110.34	1:50	13:50
Distant-Coast (Km)					282		121	73	64	20	7	5	2.5	1.5	2	0	พังงา	ท้ายหมเหลา	126.54	2:06	14:06
Distant-Coast (Km)					256		139	81	77	23	10	6	4.7	3.6	4		พังงา	ตะกั่วทุ่ง	133.79	2:13	14:13
Distant-Coast (Km)					260		158	83	78	27	16	11	7.8	4.4	4	1	พังงา	ท้ายเหมือง	138.51	2:18	14:18
Distant-Coast (Km)					257		166	84.6	79.8	32.6	13	10	5.6	3.1	3	1	พังงา	คุระบุรี	139.57	2:19	14:19
Distant-Coast (Km)					238		180	98	86.2	30.9	15	7	3.3	0.3	0		พังงา	เกาะพระทอง	140.77	2:20	14:20
Distant-Coast (Km)					244		189	110	92.3	39.1	20	12	8.9	3.3	3		พังงา	เกาะระ	148.89	2:28	14:28
Distant-Coast (Km)					186.7		119	94.8	86.7	34.6							กระบี่	เกาะศรีพี	130.73	2:10	14:10
Distant-Coast (Km)					232.8		146	121	111	33.9	10	5	3.2	0.7	1		กระบี่	เกาะลันตา	142.83	2:22	14:22
Distant-Coast (Km)					217.7		138	115	101	68.7	18	9	7.4	1.7	2		กระบี่	อ่าวนาง	147.89	2:27	14:27
Distant-Coast (Km)					228.2		158	125	114	67.6	32	20	14	3.1	3		กระบี่	อ่าวกระบี่	158.80	2:38	14:38
Distant-Coast (Km)					197		119	94.5	85.7	34.5							กระบี่	แหลมพรหมเทพ	130.71	2:10	14:10
Distant-Coast (Km)					226.4		208	168	146	65	40	26	16	28.8	19	6	กลัง	ปะเหลียน	192.86	3:12	15:12
Distant-Coast (Km)					243.8		173	136	126	43.4	19	15	13	10.4	10	0	กลัง	ท่าแร่	161.47	2:41	14:41
Distant-Coast (Km)					244		173	136	126	44	20	15	13	10	10	0	กลัง	นาคาเขาใหญ่	161.26	2:41	14:41
Distant-Coast (Km)					266.8		198	168	141	66.8	31	20	26	18.1	18	5	กลัง	นาคาราญ	178.46	2:58	14:58
Distant-Coast (Km)					254.1		203	175	128	42.3	18	9	4.1				สตูล	เกาะตะรุเตา	160.03	2:40	14:40
Distant-Coast (Km)					216.2		193	162	78.2	13.7							สตูล	เกาะอาดัง	141.31	2:21	14:21

5E: INTERNATIONAL COOPERATION

Question 80: *Are there international agencies, or through bilateral or other assistance, any countries, universities, or other technical institutions that you are coordinating, cooperating with, or who are providing services for conducting tsunami hazard and risk assessments, and/or numerical modelling?*
Answer: Yes, there are, as is reflected in the answers to previous questions.

Question 81: *If yes, please indicate who and describe the assistance.*
Answer:

Agencies	Assistance
Asian Institute of Technology	**Simulation and modeling**

5F: POST-TSUNAMI SURVEYS

Question 82: *Have post-tsunami impact assessments been conducted in your country?*
Answer: Yes, they have been conducted.

Question 83: *If yes, what types of data were collected? For example, structural and non-structural physical damage, run-up and inundation, geological, geophysical, and oceanographic tsunami signatures, emergency response, public perceptions of hazard and response.*
Answer:

Types of Data	Agencies
Coral Reef	Department of Marine and Coastal Resources in collaboration with CRC-Reef Research Center, Australia
Caves in marine national parks	Department of Mineral Resources
Sink holes	Department of Mineral Resources

Livelihoods of Coastal communities	Department of Provincial Administration, Department of Community Development, Ministry of Labor and Social Welfare
Health of coastal communities	Ministry of Public Health
Non-structural approach in risk reduction (January-July 2005) emphasis on social-interagencies-network analysis to enhance public awareness and knowledge utilization	Dr. Tavida Kamolvej, Faculty of Public Management and Policy Thammasat University Emergency Management Expert counterpart to Pacific Disaster Center

SECTION 6: TSUNAMI PUBLIC AWARENESS AND PREPAREDNESS, AND COMMUNITY-LEVEL ACTIVITIES

Scope: Please describe your country's situation regarding tsunami public awareness and preparedness. Below are some questions that should be considered in providing a description.

6A: ASSESSMENT OF LOCAL-GOVERNMENT PREPAREDNESS AND EMERGENCY RESPONSE

Question 84 : *Have you assessed your local government disaster preparedness and emergency response? For example, are there local emergency operations centres, alert systems, incident command processes for response?*
Answer: Yes, they have been assessed by Department of Disaster Prevention and Mitigation (DDPM) and Department of Provincial Administration (DPA). Dr. Tavida Kamolvej from Thammasat University, Thailand also studied and interviewed as well as surveyed to initiate factors correlated to effective national-local emergency management focusing on the locals as one of the confronting-unit to all hazards in different settings of physical and social structures around the affected areas.
Provincial Committee led by Ministry of Defense and Ministry of Interior take a key role.
Rescue operation is conducted by military forces. The local disaster relief activities are coordinated by DDPM, which is responsible for evacuation, coordination, and planning. DDPM centers are located at provincial level. Every province has emergency plan (e.g. hazard map, emergency plan, risk map for all hazards).

Question 85: *How have you ensured, or will you ensure, that the information given to ordinary citizens during a warning is understood and then acted upon in an appropriate and timely manner (for example, by meetings, mass media, schools, drills, community activities, etc)?*
Answer: Conducting evacuation exercises and community outreach programs
Tsunami evacuation drill has been conducted in 6 Provinces every month. Multi hazard drill is conducted at national level once a year. Local residents are expected to be ready to evacuate with emergency bag in 5 minutes.

Warning towers disseminate different languages/dialects used in the local area. Assessment is needed to see how many minutes it takes for people to evacuate for planning purpose.

6B: ASSESSMENT OF COMMUNITY PREPAREDNESS AND EMERGENCY RESPONSE

Question 86: *Have you assessed your community and ordinary citizen disaster preparedness and emergency response? Is there public awareness of tsunami hazard and risk?*
Answer: Yes, they have been assessed.
Survey for actions taken by ordinary citizens needs to be linked with this assessment. Navy and Army train local people and they provide temporal shelters (3,000 by Air Force), Navy takes care of the residents in remote islands.

Question 87: *Is the public aware of what a tsunami is, and how to respond to both locally-generated and distant tsunamis*
Answer: Yes, there are. There are evacuation plan provided by Department of Provincial Administration.

Question 88: *Are there any community-level education and preparedness programmes for national hazards or tsunamis?*
Answer:
Yes, there are through the Community Development Department, DDPM and DPA.
Ministry of Natural Resources (Dept of Mineral Resources) provides educational information kit to schools. Civilian Disaster Prevention Volunteers Unit takes an important role.

Question 89: *If yes, please describe how the awareness and preparedness was achieved (for example, through brochures, education, meetings, etc.).*
Answer: Awareness may be achieved through brochures, education and public consultation.

PUBLICATIONS
Department of Mineral Resources. 2005.
(1). Earthquake: Disaster Close to Us. 34 pp. Department of Mineral Resources. 2005
(2). Risk Reduction from Geohazard of Tsunami. 30 pp. (in Thai) Department of Mineral Resources. 2005
(3). Tsunami, Giant Dangerous Wave. 24 pp. (in Thai) Department of Mineral Resources. 2005
(4). Tsunami, Great Wave. (brochure in Thai) The Chaipatana Foundation. 2005.

Tsunami, a Giant Wave, Great Danger. In collaboration with U.S. National Oceanic & Atmospheric Administration (NOAA), UNESCO/Intergovernmental Oceanographic Commission (IOC), International Tsunami Information Center (ITIC) and Laboratoire De Geophysique, France (LDG). 20 pp. (in Thai)

EDUCATION
DDPM has knowledge and education programmes which were achieved by increase awareness and knowledge of public authorities and general public on nature of disasters and disaster risk reduction.
Activities were carried out by both formal and informal education and training from national to grass-root levels and integration of disaster related knowledge into educational curriculum.

PUBLIC CONSULTATION
DDPM has applied Community-based Disaster Risk Management through which at risk communities are actively engaged in identification, analysis, treatment, monitoring and evaluating of disaster risks in order to reduce their vulnerabilities and enhance their capacities.
A previous unit before the establishment of DPM (Provincial Protection Volunteer) works together with DPM at community level

Question 90: *What types of outreach have been conducted and who conducts them?*
Answer: The community-based Disaster Risk Management has been conducted by DDPM.

Question 91: *What is planned for the future to increase or sustain the awareness and preparedness?*
Answer: DDPM has carried out many activities to sustain the awareness and preparedness as follows:

- Provision of equipment and vehicles for disaster prevention and mitigation to Local Administrative organizations

- Organize command post exercise (system drill) in according to disaster preparedness, prevention and mitigation plan for each province
- Organize activities for youth (children) in disaster prevention and mitigation in certain occasion
- Organize activities for media and network of disaster reduction to provide public learning (page 32)
- Organize seminars for civil disaster prevention volunteers

6C: COMMUNITY PARTICIPATION

Question 92: *Do local authorities engage in community-level, citizen-based, stakeholder participation in developing and deciding risk avoidance and mitigation activities?*
Answer: Yes, they do. Conversations between authorities and university with local community have been conducted with involvement of NGOs and private sectors. What is needed is to consider how to reduce risk.

Question 93: *Is community-based, risk-based decision-making used? In other words, at the community level, are tsunami mitigation and emergency response decisions based on knowledge of the known local risks and the potential impacts of tsunami on the specific community?*
Answer: Yes, there are. A safety manual kit for hotels is under developing. Local volunteers are there already when planning e.g. risk map, evacuation map, a very local broadcasting system by loud speaker.

Question 94: *Informed people at the community level may be the ones best suited to make decisions for their own communities on the risk level they are willing to tolerate or retain, and the risk level they want to transfer to someone else. Have local risk assessments been carried out, or are they necessary?*
Answer: Yes, the local risk assessment has been carried out by Department of Mineral Resources. However, certain community such as Ban Nam Kem Village in Takua Pa, Phang Nga decided not to relocate their village to other safe places due to their successive stay in the areas for a long time.
In addition, Department of Country and Town Planning is making risk map for urban areas.

6D: PEOPLE-CENTERED EARLY WARNING MECHANISMS

Question 95: *Do non-government, people-centred, community-based organizations, such as the local Red Cross/Red Crescent Society, play a role in the receipt and delivery of tsunami or multi-hazard early warnings to people at the local level?*
Answer: Yes, they do. Local Administrative Organizations (LAOs) are agencies under the Department of Provincial Administration will play a major role in receive and delivery of tsunami multi-hazard early warnings to people at the community level. So far, 150 LAOs have received assistances from DDPM in acquiring equipments and vehicles in disaster prevention and mitigation such as fire-engine, water truck, and multi-purposed rescued truck, etc. with a total amount of more than 60 million U.S. Dollars.

Several Tsunami Warning Towers were installed by several companies including German and US ones.

Local RC chaired by the Princess appealed for resources from IFRC for emergency relief package, prefabricated house, school and hospital rebuilding.

Question 96: *If yes, please describe their role and activities.*
Answer: IFRD-RCS occasionally offers training session and/or co-training in paramedic and primary medical care to local emergency rescue unit such as Civil Emergency Defense Volunteer. The Department of Disaster Prevention and Mitigation also works mostly with medical care unit from the Vajira Hospital in rescue operation. Apart from this, DDPM has its own academy that trains all personnel on disaster activities. Regarding future training plan, personnel who are trained will be able to conduct training sessions with the local organizations and local authorities.

Social networks including LAOs Civil defense Volunteers to contribute to early warning.
They are trained by militaries fire brigade (7 Million members trained every year).

Many volunteers at local level have a multi-function, including autonomous activities, fire, flood, land other disaster's countermeasures.

Question 97: *If no, is there an interest in involving these organizations as an early warning mechanism that carries messages from national authorities to communities and into households? Please specify which organizations.*
Answer: --

6E: PEOPLE-CENTERED PREPAREDNESS MECHANISMS

Question 98: *Do non-government, people-centred, community-based organizations, such as the local Red Cross/Red Crescent Society, play a role in the early warning preparedness and community outreach and education to people at the local level?*
Answer: IFRD-RCS has developed its role in the early warning preparedness and community outreach and education to people at the local level. This is to develop materials to appropriate target audience, training for the trainers equipping at the National Headquarters of Thai Red Cross to improve of operation center in Bangkok. For provincial operation center, it will be decided at a later date to be at Phang Nga or Phuket.

Local RCs belong to the Thai Red Cross is very active. Rotary Foundation and Lion's Clubs are also active in this area.

Question 99: *If yes, please describe their role and activities.*
Answer: IFRD-RCS's role will take message that come from regional early warning center across to people in timely and appropriate actions.

Trainings of local volunteers are made by militaries and fire brigade. National and local Red Cross provides trainings to people.

Question 100: *If no, is there an interest in involving these organizations as a preparedness mechanism to reach communities and households? Please specify which organizations.*
Answer: --

6F: EDUCATIONAL MODULES OF THE TSUNAMI NATIONAL FOCAL POINTS

Question 101: *As the designated national tsunami focal point, do you have a tsunami education and public outreach programme currently in place or planned for the future? If yes, please describe and provide implementation time line if planned.*
Answer: We have not yet in place a tsunami education and public outreach program, but will be planned for the future.

Question 102: *How does the plan address the different stakeholders (e.g., risk managers, media, and schools)?*
Answer: This may be carried out by organizing study tours and trainings on early warning system for school children, students, managers, and media.

Question 103 : *Are other natural hazards, such as tropical cyclones, storm surges, earthquakes, and volcanoes, covered in this programme plan?*
Answer: Yes, there are. Apart from these, they will cover severe pollution (air, water and oil spill), wild fire, floods, landslide and collapse of dam.

Question 104: *How are educational materials distributed?*
Answer: They are distributed to schools, hospitals, hotels, and communities.

Question 105 : *Do you have training programmes for the media on tsunami hazards, mitigation, warning, and preparedness? If yes, please describe?*
Answer: Yes, we have. So far, there are quite numbers of media, private sectors and organizations within and outside of Thailand visiting the Center to obtain information on policy, objectives, organizational structure, responsibility, networks, and service benefit from early warning system, mitigation plan, and preparedness.

Attendants	Date	No. of Visitors
Prime Minister of Thailand, Ministers and Foreign Ambassadors and Diplomats	30 May 2005	100
AP Associated Press, Bangkok	13 June 2005	5
Bangkok Metropolitan Office	13 June 2005	Request for data on risk areas
Thai Junior Encyclopedia Project by Royal Command of H.M. the King, Thailand	15 June 2005	Request for photos of the system
BBC, London, Great Britain	15 June 2005	5
Morning Talk Channel 11	20 June 2005	5
American Researchers	24 June 2005	2
Office of Special Inter-City High Way	24 June 2005	Request for EWS information
International Federation of Red Cross and Red Crescent Societies, Bangkok Region	24 June 2005	2
TV Asia Co. Ltd., Bangkok-Germany	24 June 2005	5
Asahi Shimbun Asian General Bureau, Japan	29 June 2005	2
Researcher (Pre-cadet School)	7 July 2005	1
Department of Disaster Prevention and Mitigation (Tak Province)	8 July 2005	6
Department of Community Development	12 July 2005	74
D.M. Inter-Communication Co., Ltd	14 July 2005	5.
Panya Consultant Ltd., Thailand	18 July 2005	2
Media from Ukrane/Aerosvit/Pan Ukrain/ Tourism Authority of Thailand, Stockholm, Sweden	19 July 2005	17
Manager Daily, Weekly, Monthly	29 July 2005	5
Ericsson (Thailand) Ltd.	4 August 2005	3
The NewsHour with Jim Lehrer/TPT/PBS TV, Bangkok	1 August 2005	5
Thai Hydrologist Assembly	22 August 2005	20

Question 106: *Do you have training programmes for the media on other hazards and their vulnerability? If yes, please describe.*
Answer: Yes, same as above table.

Question 107: *Would availability of educational modules and training sessions customized to your particular culture/infrastructure be helpful to your organization and to raising public awareness in your country?*
Answer: We plan to cooperate with international as well as national and local organizations such as IOC, WMO, ADPC, PDC, ADRC, the Department of Disaster Prevention and Mitigation, Ministry of Education, etc.

Question 108: *Through what mechanisms do you interact with your major stakeholders? Would you benefit from assistance/guidance/on-going contact with your national and regional partners through seminars and workshops?*
Answer: Through Department of Disaster Prevention and Mitigation, Ministry of Education, Asian Disaster Preparedness Center, etc. Ongoing contacts with partners would be beneficial.

Question 109: *Would you benefit from on-going regional training activities strengthening the linkages of key organizations involved in the Early Warning Process (technical agencies, Media, Risk Managers, etc.)?*
Answer: Yes, we do.

6G: EDUCATIONAL CURRICULUM

Question 110 : *Are earthquake and tsunami hazards and preparedness part of the educational curricula taught to school children? If yes, please describe.*
Answer: Yes, the Ministry of Education is conducting this element. The earthquake and tsunami hazards and preparedness are part of the geography course for school children grade 1-6. The course commences in the first semester of the year 2005 in all every schools throughout the country (>30,000 schools).
School nearby sea coast had drills.

6H: OTHER OUTREACH PROGRAMMES

Question 111: *Are there other funded programmes which have provided outreach, or is there a need for such programmes?*
Answer: Yes, there are, but depending on government budget.
Ministry of Environment, Ministry of Natural Resources and Ministry of Education are keen to this. Several programmes were implemented by authorities, and some were done by private companies. e.g. More than 200,000 pamphlets on tsunami information were distributed by authorities. There is need for assistance from IOC for financial aid for reproducing more pamphlets.

Question 112: *If yes, what types of outreach are needed? For example, public awareness briefings, technical training or education, informational material (printed brochures, video, computer, etc), materials targeted for children, decision-makers, general public or targeted segments of the populations, indigenous populations.*
Answer: The public awareness, briefings, technical training or education, information materials, materials targeted for children, decision-makers, general public or target segments of the populations and indigenous populations are all needed and planned for as a community outreach programme.
There is a need for better structure for curriculum for education and trainings for volunteers at more regular bases.

6I: TSUNAMI MEMORIALS AND MUSEUMS

Question 113: *Are there any tsunami memorials, museums, interpretative signage or other public reminders of past tsunami impacts to your country?*
Answer: Yes, it will be built in Phang Nga.

Question 114: *Do you have plans to establish such reminders? If yes, please describe.*
Answer: Yes, we have. The Designated Areas for Sustainable Tourism Administration will be a focal point in establishing the tsunami memorials, museums, interpretative signage as public reminders of the past tsunami impacts in Thailand. The place will be used as a warning center locating in Phang Nga. Investment is required.

6J: STRUCTURAL MITIGATION EFFORTS

Question 115: *Has your country implemented any structural mitigation to reduce tsunami impact? Examples might be sea walls, tsunami evacuation shelters or other man-made high platforms, building codes for earthquake-resistant, flood-prone, or typhoon-resistant structures, or vertical evacuation guidance? If yes please describe.*
Answer: Data not available, but Department of Provincial Administration is looking for structural development in the impact areas.

Princess Foundation is to build a number of tsunami warning tower functions as shelter for evacuation. Ministry of Natural Resources and Ministry of Environment in cooperation with Militaries make mangrove forest to reduce tsunami impacts. Building codes are developing.

6K: NON-STRUCTURAL MITIGATION INCLUDING LAND USE

Question 116: *Has your country implemented any non-structural mitigation, such as land-use policies regarding the location and building of structures or public utilities in potentially hazardous coastal areas, vegetative sea barriers, or the retaining or rebuilding of key features of the natural landscape or ecosystem that can serve to buffer the effects of future national disasters? If yes, please describe.*
Answer: Yes, relocations of communities and local entrepreneurs.
Relocation of houses based on hazard map has been conducted. Law prohibits certain houses to build in the area at risk. There is regulation to use coastlines for effective land use. Risk management plan exists.

6L: EVACUATION ISSUES

Question 117: *Have tsunami evacuation maps, evacuation routes, and evacuation signage been developed for any part of your country?*
Answer: Yes, there are. Evacuation maps have been provided.

Question 118: *If yes, please indicate where and how they were assembled.*
Answer: The Department of Mineral Resources has produced the tsunami evacuation maps, evacuation routes, whereas the Department of Disaster Prevention and Mitigation has established evacuation signage. These maps and signage were generated and installed in Phuket (the Kamala, Kata, Karon and Patong Beaches), Phang Nga (Khao Lak) and Krabi (Phi Phi Island).

Question 119: *If no, does your country plan to do this in the future*
Answer: --

Question 120: *Is training required to build this capacity?*
Answer: Yes, we do need.

6M: INTERNATIONAL COOPERATION FOR AWARENESS

Question 121: *Are there international agencies, or through bi-lateral or other assistance, any countries, universities, or other technical institutions that are you coordinating,*

cooperating with, or who are assisting in the development of materials or the deployment of information to the relevant institutions and/or the public?
Answer: Yes, there are.
More funding is needed for more signs in local area. Expand and deepen the development of public awareness, facilities, materials, and capabilities. Tsunami experts needed

Question 122: *If yes, please indicate who and describe the assistance.*
Answer: NDWC seeks assistance from USTDA, USAID, PDC and ITIC.

6N: INTERNATIONAL COOPERATION FOR STRUCTURAL AND NON-STRUCTURAL MITIGATION

Question 123: *Are there international agencies, or through bi-lateral or other assistance, any countries, universities or other technical or humanitarian assistance institutions that are you coordinating, working with, or who are providing services to strengthen your structural and non-structural tsunami mitigation activities at the local levels?*
Answer: Yes, there are.

Question 124: *If yes, please indicate who and describe the assistance.*
Answer: The Germany Company, namely SiRcom & Kockom donated three warning towers at the Patong Beach in Phuket. IOC's support would be appreciated.

UNDP is to provide tidal gauges (2 of them cost USD 70,000)
Norway is to provide fund to a desalinization plant.

SECTION 7: TSUNAMI RESPONSE TO 28 MARCH 2005 M8.5 EARTHQUAKE OFF SUMATRA, INDONESIA

Scope: Please describe your country's response to this earthquake which did not generate a destructive basin-wide tsunami.

7A: PREPAREDNESS

Question 125: *Was your country more aware and your public better prepared to respond appropriately? Please describe how you ascertained this.*
Answer: Yes, right now, the country is more aware and public are better prepared to respond to earthquake. This can be described through interviews of Governors and officers dealing with community evacuation in which people were evacuated as planned with very few cases of public disorder such as traffic congestion. Apart from the information obtained, almost every television channels and radios were very well cooperated with Government in informing public on update information and relief.

Question 126: *Did they respond appropriately?*
Answer: Yes, they did.

7B: ADVISORY

Question 127: *Did your country receive an internationally tsunami advisory message from the PTWC or JMA?*
Answer: Yes, TMD received tsunami message from PTWC via email and phone call, and from JMA through GTS.

Question 128: *How timely was this?*
Answer: It took about 20 minutes for JMA to inform TMD. NDWC was not operating at that time. So, the earthquake situation and information was monitored by the Meteorological

Department. TMD announce warning message to public about 25-30 minutes after the eathquae occurred.

7C: MONITORING SYSTEMS

Question 129: *Did your country have national monitoring systems in place that detected and evaluated the earthquake?*
Answer: Yes, we have, but additional improvement is in process.

Question 130: *How timely was this?*
Answer: within 20 minutes

7D: NATIONAL RESPONSE PLAN

Question 131: *Did your country have a national tsunami response plan in place, and was it exercised?*
Answer: Yes, we have. It was exercised in April and July for tsunami evacuation by the provinces.

Question 132: *How did it perform?*
Answer: It was successful and was achieved in 40 minutes.

Question 133 : *What went well and what are areas still needing coordination and improvement?*
Answer: It went well in part of evacuation plan. However, it needs a central command system to inform public with single command direction and information.

SECTION 8: OVERALL ENHANCEMENT OF YOUR NATIONAL CAPABILITIES TO MITIGATE THE IMPACT OF HAZARDS (WMO)

Question 134: *Is your country addressing the establishment of the Tsunami Early Warning capabilities including response within your national boundary, with a multi-hazard framework? If (yes) please explain.*
Answer: Yes, we addressed the establishment of the Tsunami Early Warning capabilities including response within national boundary, with a multi-hazard framework. This is due to the fact that Prime Minister Thaksin Shinawatra of Thailand has given his policy at the opening ceremony of the NDWC on May 30, 2005 to do as much as possible to save people's lives and properties which will be affected from all types of disasters.

Question 135: *In the absence of a tsunami, how can you benefit from with the capacities and linkages being developed in your country, to better respond to other hazards?(e.g. improved dissemination, coordination and response to all hazards affecting your country)*
Answer: NDWC will certainly be able to respond to all multi-hazards in Thailand using effective and durable early warning system developed in the framework of Tsunami Early Warning System.

Question 136: *We would especially appreciate if you could comment further on critical areas where the international community can provide additional specialized technical or capacity building assistance.*
Answer: More technical training especially on sea level data gathering, equipment knowledge and data interpretation and application. In addition, telemetry system.

ANNEX III

adpc Asian Disaster Preparedness Center

NDWC, THAILAND

Memorandum of Understanding
In
Cooperation on Early Warning Arrangement, Preparedness and Mitigation on Natural Hazards for Thailand
between
Asian Disaster Preparedness Center
and
National Disaster Warning Center, Thailand

The Asian Disaster Preparedness Center (ADPC) is a Regional, Inter-Governmental, non-profit organization based in Thailand mandated to promote safer communities and sustainable development through the reduction of the impact of disasters in response to the needs of countries and communities in Asia and the Pacific by raising awareness, helping to establish and strengthen sustainable institutional mechanisms, enhancing knowledge and skills, and facilitating the exchange of information, experience and expertise.

National Disaster Warning Center, Thailand (NDWC) of the Thai Government was inaugurated by H.E. Prime Minister Thaksin Shinawatra on 30th May 2005 with a responsibility to provide early warning using central command system on a nation-wide basis. NDWC will receive information from Thailand, regional and international sources. NDWC will be in-charge on all types of disaster which will affect lives and property of all persons in Thailand to ensure that all possible preventive measures are taken to maintain normal daily life in Thailand, reduce loss and render to all persons a safe working environment. NDWC will be a Center of Excellence for planning, coordination, monitoring, and supervision of all related agencies of the Royal Thai Government in implementing disaster warning, preparedness, mitigation and recovery services.

RECALLING H.E. Prime Minister Thaksin Shinawatra's announcements in the 'Ministerial Meeting on Regional Cooperation on Tsunami Early Warning Arrangement' on 29 January 2005 in Phuket, and the declaration of the 'Regional Meeting on End-to-end Multi-hazard Early Warning System Southeast Asia: Assessment of Needs' (28-29 March 2005, Bangkok) and the directions of H.E. Prime Minister Thaksin Shinawatra in the meeting on 26th August 2005 on the roles of ADPC and NDWC

THEREFORE, in recognition of the importance of early warning arrangement, preparedness and mitigation on tsunami and other natural hazards for Thailand, the Parties hereby agree as follows:

Article 1
Objective

The Parties shall, in accordance with their prevailing laws and regulations and on the basis of mutual benefit, particularly in the area of the Thai Government's responsibilities for early warning arrangements for Thailand, establish collaborative linkages in respect of natural hazards early warning arrangements.

Article 2
Areas of Cooperation

The areas of cooperation under this MOU may include, but are not limited to, the following:

1) Early warning arrangement, preparedness, and mitigation of natural hazards for Thailand;
2) Establishment of cooperative linkages between ADPC and NDWC.

Article 3

Role of Asian Disaster Preparedness Center (ADPC)

a. The ADPC serves as *the Regional Early Warning Center for participating countries in the Indian Ocean and South East Asia*;
b. To collaborate with Cambodia, China, Lao PDR, Myanmar, the Philippines, Singapore, Thailand, Vietnam, and other participating countries to establish a regional network of real-time earthquake monitoring and sea-level observing stations;
c. To collaborate with the Thai Government agencies through NDWC as a focal point for Thailand toward the establishment of sea level observing and earthquake monitoring stations in Thailand;
d. To exchange real-time monitoring data from all sea-level observation and earthquake monitoring stations of the ADPC regional network with NDWC and vice versa for the sole purpose of delivering early-warning services;
e. To provide advisory warning information to NDWC and other participating national warning centers;
f. To provide training to enhance capabilities of NDWC if required;
g. To cooperate with NDWC in any other necessary activities to enhance the over-all performance of the early warning system.

Role of the National Disaster Warning Center, Thailand (NDWC)

a. The NDWC serves as *the National early warning center for the Kingdom of Thailand;*
b. The NDWC serves as a focal point of Thailand for ADPC in coordination with other Thai Government agencies in establishment of sea level observing and earthquake monitoring stations in Thailand;
c. To utilize real-time monitoring data from all sea level observing and earthquake monitoring stations of the ADPC regional network linked to NDWC;
d. To exchange real-time monitoring data from all sea-level observation and earthquake monitoring stations with ADPC and vice versa for the sole purpose of delivering early-warning services;
e. To act as a Center of Excellence for planning, coordinating, monitoring and supervising all related agencies of the Thai Government in implementing disaster preparedness, mitigation, and recovery services;
f. To coordinate and collaborate with Thai Government agencies to ensure upkeep and maintenance of sea level observation and earthquake monitoring system on a sustained basis;
g. To avail training for NDWC professionals from ADPC as required by NDWC;

h. To cooperate with ADPC in any other necessary activities to enhance the over-all performance of the early warning system.

Article 4
Financial Obligations

Financial obligations if any shall be determined by the Parties through mutual consultation and agreement on a case by case basis, in accordance with the regulations of each Party.

Article 5
Settlement of Differences

Any differences between the Parties concerning the interpretation and/or application of this MOU shall be settled amicably through mutual agreement.

Article 6
Entry into Force, Amendment and Termination

(1) This MOU shall enter into force on the date of its signature. It shall remain enforce until terminated by either of the parties.
(2) This MOU may be amended by written agreement between the Parties hereto and shall become effective upon written agreement of all Parties of such amendments.

IN WITNESS WHEREOF, the undersigned, being duly authorized thereto, have caused this document to be executed in Thailand.

Signed in two originals in the English Language on this day of September 6th, 2005

For
Asian Disaster Preparedness Center

Dr. Suvit Yodmani

Executive Director

For
National Disaster Warning Center,
Thailand

Dr. Plodprasop Suraswadi

Vice Minister to the Ministry of Natural
Resources and Environment
Executive Director